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EPONYMS.

BY SIR D'ARCY POWER, K.B.E., LONDON.

XVII. CHARCOT'S JOINTS.

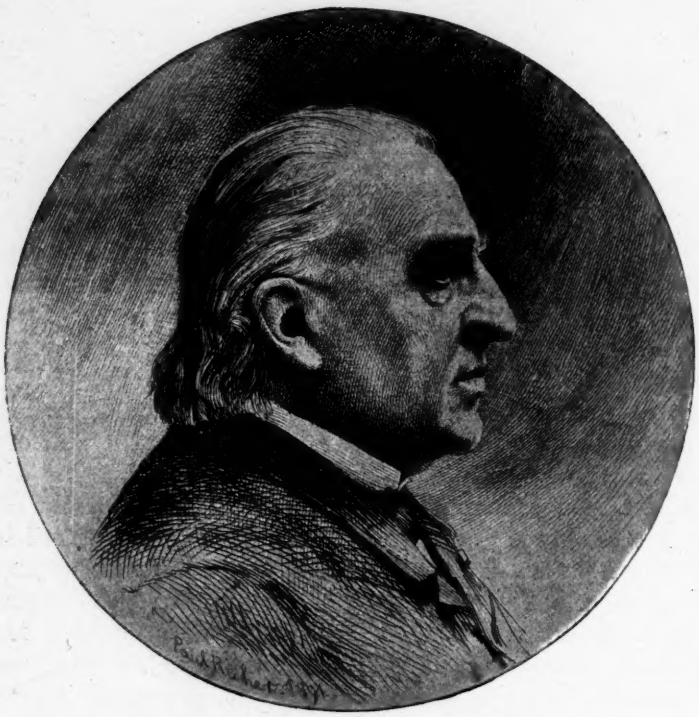
ALTHOUGH Charcot was a physician, it is befitting that the BRITISH JOURNAL OF SURGERY should share in commemorating one who was ever friendly to the English-speaking nations, and they in return were the first to use the term 'Charcot's joints'.

Jean Martin Charcot was born in Paris on Nov. 29, 1825. His father was a coachbuilder, who told his three sons that he could not bring them all up to a liberal profession. The one who did best at the end of his year at school should continue his studies, the second should become a soldier, and the third should be a coachbuilder like himself. Jean Martin did best, and was sent on to the Lycée Saint-Louis, where he remained until he began his medical education in 1844. He became 'Interne des Hôpitaux' in 1848, was appointed to the Salpêtrière, and collected there the material for the inaugural thesis on arthritis nodosa with which he graduated M.D. in 1853. For the next two years he served as 'Chef de Clinique', making money enough by private teaching to repay his parents for the pecuniary sacrifices entailed by his education. In 1856 he was Physician to the Central Bureau of the Paris Hospitals, and four years later he became Professor Agrégé. In 1862 he was appointed Physician to the Salpêtrière, an asylum for the aged and infirm, where he remained until his death. He succeeded his friend Vulpian as Professor of Pathological Anatomy in the medical faculty in 1872, and performed the duties until the faculty, in 1882, asked that a Chair of Clinical Neurology should be attached to the Salpêtrière, and Charcot chosen to fill it. He was elected a member of the Academy of Medicine in succession to Cruveilhier in 1872, and in 1883 he became a member of the Institute. He died of angina on Aug. 16, 1893, unexpectedly, although it had been clear to his friends that his health had been failing for some time before his death.

In person Charcot bore a strong resemblance to the Bonapartes, and more especially to Prince Jérôme. He was a man of wide interests: music, painting, art, and literature equally attracted him, and thanks to a fortunate

and happy marriage he was able to cultivate these hobbies as well as the purely scientific side of his profession.

Arthropathies, or affections of the joints associated with injuries of the nerves and diseases of the nervous system, had already attracted the attention of Weir Mitchell and Duchenne, but it was left to Charcot to study them carefully and to differentiate them from gout, rheumatism, and what is now termed osteo-arthritis. Tabetic arthropathy interested him from the beginning of his teaching at the Salpêtrière. He only recognized at first the hydrarthrosis which is of not infrequent occurrence in locomotor ataxy. The dramatic suddenness with which it appears, and its gradual improvement in many cases, led him to a closer study, and he discovered that a form existed in which



JEAN MARTIN CHARCOT.
From an Etching by Professor Paul Richer (1891).

the articular ends of the bones underwent great and rapid changes. The preparation (*Fig.* 1) which he presented to the Museum of the Royal College of Surgeons in 1877 (*General Pathology*, 1022.1) was amongst the first, if not the very first, which he described in detail. He says (*Archives de Physiologie normale et pathologique*, 1869, ii, 121):—

"A woman aged 49 was admitted to the Salpêtrière on May 1, 1867. She had begun to suffer from symptoms of locomotor ataxy ten years previously, and she had been bedridden for the last four years. She noticed on awakening in the morning of June 9, 1860, that her left shoulder was swollen, the swelling getting progressively less until it reached the wrist. She was not feverish, there was no pain, and she was quite unable to account for the swelling.

Three days later the swelling had disappeared from the arm and forearm, but the shoulder still remained larger than normal, and there was marked creaking when the joint was moved.

"On June 18, in addition to the general swelling of the shoulder, there was a rounded swelling about the size of an orange situated in front of the joint. It fluctuated, and appeared to be a distended subdeltoid bursa. The creaking in the joint was still more marked. Matters remained in this state until Aug. 2, when the patient was seized with diarrhœa, choleraic in character, of which she died on Aug. 15. The swollen shoulder became much smaller a few days before death.

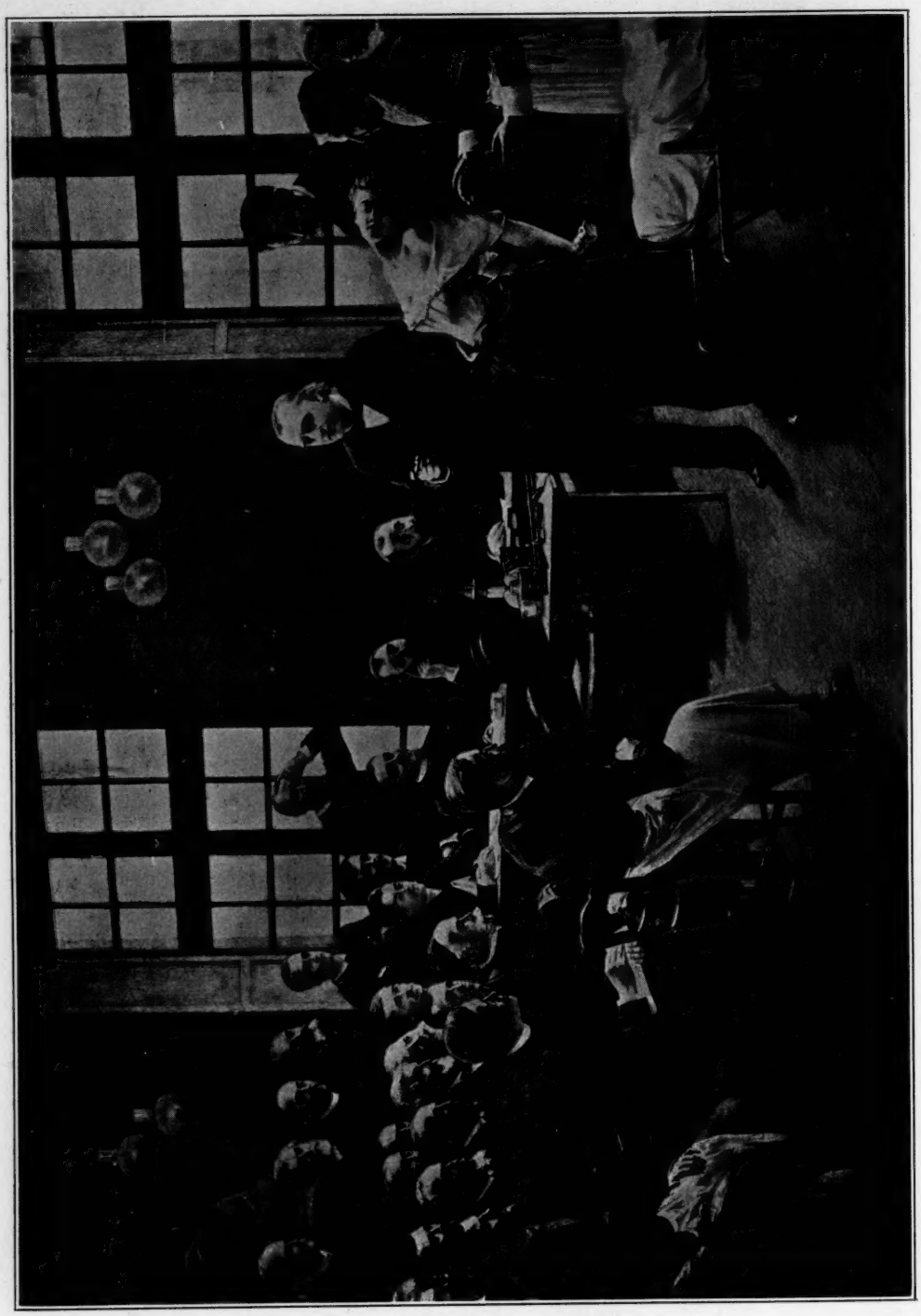
"A post-mortem examination made on Aug. 16 showed that the capsule of the joint was much thickened, and contained some bony plates in its substance. The synovial membrane was also thickened, and was slightly reddened on its inner surface. The cavity of the joint contained a little transparent yellow fluid, and there were intra-articular loose bodies. The head of the humerus had undergone the remarkable changes shown in the accompanying figure (*Fig.* 1). Although the arthropathy had only lasted nine weeks, a large part of the head of the bone had disappeared as if it had been rubbed away by friction. There was no trace of the articular cartilage, and the globular head was replaced by a flat or slightly concave surface, worn away and roughened in some parts, smooth and eburnated in others. A few small rounded osteophytes surrounded this surface, but they were quite unlike the bony edges which surround and enlarge the joint surfaces in osteo-arthritis.

FIG. 1.—Tabetic arthropathy, showing changes in the head of the humerus.

"The glenoid cavity showed similar changes. The surface was worn away like the head of the humerus, but to a lesser extent. Every trace of articular cartilage had disappeared, and there was no lipping of the bone. The clavicle and acromion were normal in appearance. The posterior columns of the spinal cord showed in a high degree the lesions of grey degeneration with atrophy, more especially in the dorsal and lumbar regions. The cervical cord was affected in the same way, but to a less extent. The posterior nerve-roots were clearly atrophied and of a greyish colour. There were slight traces of a posterior spinal meningitis."

Charcot must have prized this specimen very highly, for the woodcut illustrating it is used in his *Leçons sur les Maladies du Système nerveux faites à la Salpètrière*, Paris, 1873, ser. ii, p. 65; in the *Leçons* of Jan. 1, 1875, 2nd ed., p. 120; and in the English translation of the *Lectures on the Nervous System*, published by the New Sydenham Society in 1881, ser. ii, p. 56.

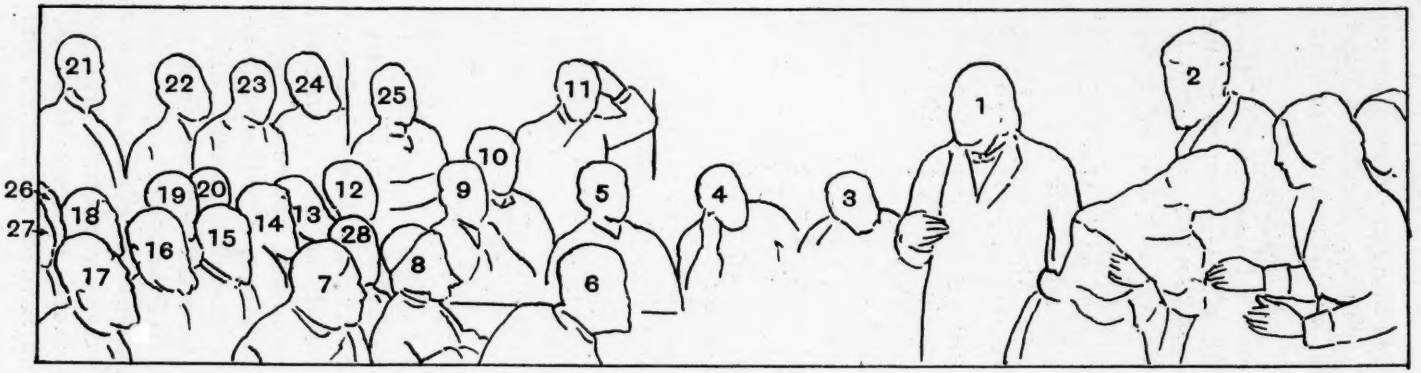
The lesions in tabetic arthropathy became common knowledge in England after the International Medical Congress held in London in 1881, when Charcot gave a remarkable demonstration of specimens. He showed the wax model of a woman, age 60, as one of the best existing specimens exhibiting the



A DEMONSTRATION BY DR. CHARCOT AT LA SALPÊTRIÈRE.

UNIV. OF MICH.

KEY BLOCK TO THE ILLUSTRATION.



1. DR. CHARCOT
2. Dr. Babinsky
3. Dr. Paul Richer
4. Dr. Féré
5. Dr. Marie
6. Dr. Gilles de la Tourette
7. M. Henry Berbez (interne)
8. Dr. Vigouroux
9. Dr. Paul Berbez
10. Dr. Brissaud
11. Dr. Joffroy
12. Dr. Ballet
13. Dr. Bourneville
14. Mr. Naquel
15. Mr. Claretie
16. M. Lebas (Directeur de la Salpêtrière)
17. M. Londe
18. M. Guinon
19. Dr. Gombault
20. Mr. Paul Arène
21. Dr. Cornil
22. M. Burty
23. Dr. Debove
24. Dr. Mathias Duval
26. M. Jean Charcot
26. Dr. Le Lorrain
27. M. Ribot
28. Dr. Parinaud

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character of ataxic affections of the joints. He afterwards presented the model to the museum of St. Thomas's Hospital, where it may still be seen under a glass case on the floor of the museum. He also gave a shoulder-joint showing tabetic arthropathy to the museum at Manchester. Sir James Paget, President of the Congress, wrote on Aug. 5, just before this remarkable exhibition :—

" My dear Professor Charcot,

" As you will be speaking on the morbid conditions of the joints and the bones associated with locomotor ataxy, I beg you to let me call your attention to a question, whether these are not instances of a disease which has lately for the first time appeared, or, at least, has lately become much more frequent than formerly it was.

" There is, I think, evidence for this opinion in the fact that specimens of this disease are rarely, if ever, to be found in any but the most recently collected museums. I can speak positively of only some of those in London, but among them are the museums of the Royal College of Surgeons and of St. Bartholomew's Hospital, in which are specimens of diseased bones and joints collected from 1770 to the present time. Till the time at which you called attention to these morbid states, neither of these museums contained one specimen ; and yet they include all the examples of diseased bones collected by many surgeons and good anatomists, some of whom preserved every bone that appeared to them strange or rare. I refer particularly to John Hunter, Howship, Langstaff, and Stanley, of whom I can be quite sure that if they had ever seen specimens of the disease which you have described, they would have regarded them as treasures to be carefully preserved. No specimen has been preserved by any one of them ; and yet they gathered all that was unusual in morbid anatomy from hospitals, dissecting rooms, workhouses, and graveyards.

" I take the liberty of suggesting this question to you as one of great interest, not only in general pathology but in the history of diseases. Besides it may lead many to believe, as I do, that a good pathological museum may be a valuable historical record.

" Believe me, my dear Professor, sincerely yours,

JAMES PAGET ".

A note is appended to this letter, probably by the Honorary Secretaries of the Congress, Sir William McCormac and (Sir) George Makins, that : " It is extremely remarkable to relate, and pathologically as well as historically noticeable, that neither in the great museums of France or England, nor any place known, prior to the observation of Charcot, were there any characteristic specimens of this disease. Thus in the Musée Dupuytren, which is usually known as containing fine specimens of all sorts, and is rich in bone disease, there was no specimen showing this disease of the bones, until Professor Charcot presented three or four specimens of the kind. The disease is, in fact, a distinct pathological entity and deserves the name, by which it will be known, of ' Charcot's disease ' ". And by this name it is known to this day.

Many specimens of Charcot's joints have been collected and preserved since 1881, and the Museum of the Royal College of Surgeons of England alone contains seventeen examples of the affection.

TUMOURS OF THE TESTICLE: THE TERATOID GROUP.

By F. GORDON BELL, Edinburgh and Dunedin.

The material forming the basis of this investigation consists of fifty specimens of testicular tumours nearly all of which are preserved in the Edinburgh University Surgical and Anatomical Museums, the others being kindly lent by friends. These two collections appeared likely to contain an adequate representation of the commoner new growths of the testicle, and likely also to offer a fair estimate of the relative frequency of the different types. Only these cases are included in the statistical review; but, in addition, ten other specimens were selected from the Museum of the Royal College of Surgeons of Edinburgh with the object of further investigating the teratoid group, and free use is made of any points elicited from them in the general consideration of the teratoid tumours and their wider application.

Certain difficulties are attached to an investigation of testicular tumours on any scale. In the first place they are rare tumours, estimated recently by Southam and Linnell to appear once in 1500 male surgical hospital admissions, a figure which corresponds closely to Russell Howard's estimate of the London Hospital cases. Consequently, many of the specimens appearing in surgical museums are of considerable antiquity, and likely to be past their best from the histological point of view. The writer has, however, been agreeably surprised at the excellent state of preservation of many of the older specimens, which is good enough for more than the cruder recognition of the various blastodermic derivatives in teratoma, though occasionally found wanting when the interpretation of the more exact cellular pathology is at stake.

Anyone investigating a fairly large collection of testicular tumours will undoubtedly encounter many puzzles. These lie not so much in the multiple-tissued tumours—for, once a teratoid origin is suspected, further examination usually produces confirmatory evidence—but centre rather in the so-called medullary, highly cellular, apparently homogeneous variety, when it is sometimes difficult to say whether a particular specimen is predominantly cancerous or sarcomatous, and still more difficult to arrive at an estimate of its precise origin. The investigator will, however, get his reward in the education provided by the great variety of pathological tissues which come up for review.

No subject in the entire range of surgical pathology has produced more diversity of opinion than the interpretation and attempted classification of new growths of the testicle. They are regarded by some as predominantly cancerous, by others as sarcomatous, and yet again as teratoid in character, —and recent papers show that there is still little unanimity of opinion. Nicholson, in Great Britain, did good service by demonstrating that the

traditional frequency of sarcoma was much over-estimated. Chevassu, in France, brought into prominence the séminome or spermatocytoma—a cancer of supposedly seminal-celled origin, regarded by some as the most frequent new growth of the testis, while Wilms, in Germany, and Ewing, in America, have done much to advance the teratoid aspects of the problem.

It may be stated at once that, so far as observations on the present series go, it appears that the vast majority of testicular tumours fall into two main categories: (1) The *teratoid* group; (2) The *germinal-celled* variety, which is variously designated germinal-celled carcinoma, seminoma, spermatocytoma, embryonal carcinoma, and round-celled sarcoma. The teratoid group has predominated to a marked degree, and is discussed here, leaving the consideration of the more difficult highly cellular type to a second paper. To avoid repetition, only certain specimens are described in detail, and these are selected and grouped as far as possible to illustrate important points which have a direct bearing on the wide field of testicular neoplasms in general.

Though no vital new facts emerge from this investigation, it is hoped that the following presentation of the subject may help to clarify some of the difficulties attached to it. I am greatly indebted to the publishers for their generosity in the matter of microphotographs, which go far to illustrate the main points.

TERATOMA TESTIS.

General Considerations.—

DEFINITION.—'Teratoma' testis may be defined as a tumour composed of elements derived from all *three* layers of the blastodermic vesicle, the derivatives being represented in differing degrees and in varying grades of complexity. This definition is too rigid, for, as will be shown presently, there are many cases in which representative elements of only *two* layers of the blastoderm are present, and, proceeding further, there is every probability that frequently only *one* layer is represented.

The term 'teratoma' should perhaps be reserved for the rare, highly complex types displaying structures which can reasonably stand interpretation as a successful attempt on the part of the tumour to produce adult or fully formed structures or organs such as the alimentary tract, bones, kidney, thyroid, breast, spinal cord, and so on; while the term 'teratoid' should be applied to the common, less complex types where the activities of the tumour are abortive and produce only a mixture of tissues. As numerous gradations occur and indicate that these tumours all belong to the same family, the terms 'teratomatous' and 'teratoid' are used synonymously in the following sections. The term 'mixed tumour' often applied to the teratoid group is in this article restricted to a special type which resembles certain parotid tumours.

There is a tendency on the part of one school of pathologists to extend the scope of teratoma testis, and to regard almost all testicular tumours as of teratoid origin, with the highly cellular homogeneous varieties classed variously as sarcoma and carcinoma by other observers as one-sided developments of the teratoma. This conception, the germ of which dates back to the pioneer work of Kocher and Langhans,[1] has the able advocacy of Ewing,[2] and is highly attractive, as providing a common origin for the great variety of tumours met

with in the testis ; but in the writer's opinion it goes too far, and the evidence against this universal application will be discussed in a second paper.

TERMINOLOGY.—It is convenient here to refer to the older terminology applied to testicular tumours. The teratoid group has in the past paraded under various designations, of which perhaps the most popular has been 'fibrocystic disease', a term receiving justification from the naked-eye and cruder microscopic appearance of a cyst supported by a matrix of fibrous tissue. Various other terms, such as 'chondroma', 'chondrosarcoma', 'chondro-adenoma', 'osteoma', 'adenoma', 'squamous- and columnar-ceiled carcinoma', are referable to the most obvious histological features occasionally displayed which have dominated the mind of the pathologist. These older terms serve as an indication of the remarkable structural variations presented by these tumours, which are now regarded as variations from a common teratoid basis.

Macroscopic Features.—Teratoma testis presents variations in size from a golf ball up to the fœtal head. The surface may be smooth or lobulated, may appear uniform in consistence, or may be soft or even fluctuant in parts, and sometimes stony hard. The internal structure is best demonstrated by (vertical) sagittal section, which brings out the relation of the tumour to the body of the testis and to the epididymis, and may in early specimens clearly demonstrate its frequent origin from the mediastinum testis. In the early stages the body of the testis is usually visible to the naked eye at some part of the periphery of the tumour, commonly at the summit, and may be fairly normal in shape and size, while in large tumours it undergoes progressive compression till it is reduced to a narrow strap-like peripheral layer only detectable under the microscope. The presence of a peripheral band of testicular tissue separated from the tumour substance by a condensed fibrous layer or capsule is highly characteristic of teratoma, but not pathognomonic (*Fig.* 2).

FIG. 2.—*Teratoma :* Low-power view showing general structure. Remains of testis at periphery, separated from the cystic teratomatous tissue by a capsule or condensation of fibrous tissue. Numerous spaces of an intestinal character (hypoblast), one at left edge containing a rod of stratified epithelium capped by horny laminæ (epiblast), and two small pale nodules of cartilage (mesoblast).

The cystic character is often evident, the cysts varying in size from a pin's head to a marble, or larger. In some of the older specimens the appearance is most aptly compared to a coarse sponge, while in recent cases the cut surface is often honeycombed and is strongly reminiscent of a colloid goitre, and the cyst contents are serous, mucoid, gelatinous, or blood-stained. The cystic character may be general or patchy, and considerable parts of the cut surface may present a solid homogeneous appearance. As in other cystic

tumours, irregular cavities may result from breaking-down of the cyst walls. While a cystic appearance is highly characteristic of teratoma testis, numerous apparently solid tumours occur in which the teratoid character comes as a surprise on microscopic examination.

Cartilaginous nodules are sometimes visible in the cut surface, and in rare cases may appear to the naked eye to form the bulk of the tumour, and to justify the old term of 'chondroma testis'. Like the cysts, the cartilaginous islets vary greatly in size and distribution, some being only just visible, while others appear as nodules the size of a cherry.

Microscopic Features.—

Method of Study and General Remarks.—The histological characters and general structure of testicular tumours are undoubtedly best studied by means of the 'whole section' method. This, unfortunately, has been only partially available, and it has been necessary to fall back on the more laborious and less satisfactory plan of taking individual sections from various parts of the tumours. It is important to pay attention to the periphery, and especially to the region of the upper pole of the specimen, for it is here that the remains of the testis proper are so often encountered, and the discovery of testicular tissue separated from the neoplastic tissue by a condensation of fibrous tissue is strongly presumptive evidence of a teratoid origin. It cannot be emphasized too strongly that the examination of a small piece of these complex tumours may be highly misleading. Again and again repeated sections have demonstrated the teratoid character in cases where the first section suggested a simple cellular tumour, and furthermore the various blastodermic derivatives show an occasional tendency to be aggregated in one area and appear to dominate the histological picture in the absence of further examination. Thus, in *Specimen* 1, presently described, the striking feature in the original section taken fifteen years ago was the presence of stratified epithelium with typical cell-nest formation, which naturally suggested a diagnosis of epithelioma; while in recent sections hypoblastic elements of an intestinal character markedly predominated. Similarly, a cartilaginous formation may appear to be the chief or even sole feature, but further search almost always reveals other elements. Paget's[3] much quoted malignant enchondroma is a case in point: it was finally shown by repeated investigation to contain all three blastodermic elements, and placed conclusively in the teratoid category.

Fig. 3.—*Teratoma:* Showing general structure and representative elements of all three layers of the blastoderm in the same field. *Mesoblast:* Nodule of darkly-stained cartilage near centre, and abundant fibro-myxomatous matrix. *Hypoblast:* Various spaces lined by columnar or cubical epithelium. *Epiblast:* Rod of stratified epithelium bounded by Malpighian layer (right).

In general it may be said that teratoma testis displays histological characters of a highly variable complexity, and the individual representation of the blastodermic layers varies greatly in different specimens. After examining a considerable number of these tumours it is possible to reduce them to a group type which, in order to give a composite histological picture (*Fig.* 3), may be briefly described as follows :—

1. *Mesoblastic Derivatives.*—The presence of cartilage in the form of round or oval nodules or crescentic plates is characteristic. A fibrocellular myxomatous matrix, sometimes sarcomatous in type, is almost equally characteristic, and always suggests that any tumour under consideration is teratoid in character.
2. *Hypoblastic Derivatives.*—These take the form of tubules or spaces lined by cubical or columnar cells, often suggesting adult glandular structures, especially intestinal mucosa.
3. *Epiblastic Derivatives.*—These take the form of spaces lined by stratified squamous epithelium, and cell-nest formation is often a striking feature.

To summarize, the common mesoblastic element (other than stroma) is represented by cartilage, the hypoblastic by glandular tubules or spaces, and the epiblastic by stratified epithelium. These and other derivatives will now be considered in greater detail.

Blastodermic Derivatives Considered more Fully.—No attempt has been made to identify all the tissues which may appear in these tumours. This is already a well-tilled field, and as there is no reason why any or all tissues and organs of the body should not be represented, the subject loses its interest. A short account of the tissues commonly met with as depicted by the present group is given with the object of considering the possible relations of these tissues to the development of tumours by a process of individual overgrowth.

1. MESOBLAST.—The formed elements are represented by hyaline cartilage, bone, plain and striped muscle, fat, and lymphoid tissue.

Hyaline cartilage is the most frequent and striking derivative, and takes the form usually of round or ovoid nodules of greatly varying size ; but sometimes it appears as plates or crescents disposed around glandular spaces, perhaps suggesting the structure of the trachea. It is sometimes so abundant as to give the tumour the naked-eye appearance of an ordinary chondroma, but may be extremely scanty. It ranges in structure from an embryonic character up to the ordinary adult type, and in some of the larger nodules active proliferation may suggest a malignant change, but the nodules practically always appear to be well encapsuled by fibrous tissue or occasionally by plain muscle. Myxomatous degeneration is often a marked feature, and central cystic degeneration in the larger islets may be visible to the naked eye ; but after comparison with a considerable number of mixed parotid tumours, the cartilaginous element of the teratoma testis appears to possess a better developed structure and is not so subject to gross myxomatous degeneration.

Bone is not a common feature, but may appear in pure form or as a partial ossification of cartilaginous nodules. The presence of ossification on an extensive scale no doubt accounts for the cases of osteoma recorded in the past.

Plain muscle is a common element, and may be distributed irregularly,

but sometimes surrounds cartilaginous nodules, and is frequently disposed around glandular spaces, where it may be taken to represent an attempt to form the muscle coat of rudimentary intestine. Its overgrowth may be related to the development of the rare myoma testis.

Striped muscle has been a rare element in the specimens under consideration, but has appeared in both embryonic and adult forms. Similarly its overgrowth may be related to the extremely rare rhabdomyoma or rhabdomyosarcoma testis.

Heart muscle is said to be excessively rare, and has not been observed in the present cases.

Lymphoid tissue is frequently present. It may have an irregular nodular distribution, but is commonly seen in association with glandular spaces lying between the epithelial and muscular layers, and doubtless representing the lymphoid tissue of the digestive tract. It is also commonly observed in malignant cellular tumours, forming a lymphoid stroma or network around the alveolar groups. It has been suggested that overgrowth of the lymphoid tissue of a teratoma may give origin to lymphosarcoma testis. This subject is discussed later, but in the meantime the frequent presence of lymphoid structures in teratoid tumours should be noted.

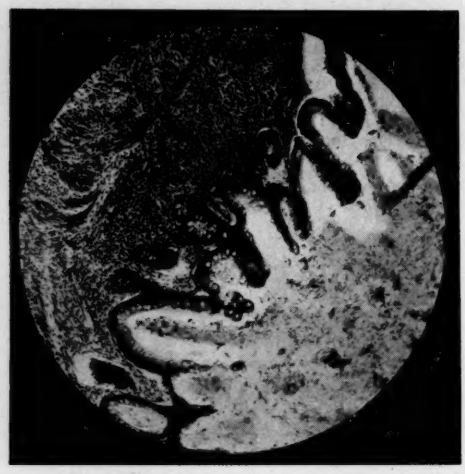

FIG. 4.—*Teratoma :* 'Intestinal tube'. Wall of space lined by columnar cells, many of which are of the goblet variety. Note the lymphoid tissue between the mucosa and the plain muscle coat.

2. HYPOBLAST.—This is represented by glandular tubules or spaces lined by cubical or columnar cells. Such cells may be of an undifferentiated type, representing, as it were, a rudimentary hypoblastic element as seen in the early embryo ; but frequently the spaces are so arranged as to suggest that they indicate an abortive attempt on the part of the teratoma to produce typical fully-formed tissues or organs, especially digestive or respiratory tracts.

Digestive tubes are lined by columnar cells, and the goblet or mucigenous type is the striking feature. Both small and large intestine may be represented, and the resemblance to adult gut is strengthened by collections of lymphoid tissue beneath the epithelium and by encircling bands of plain muscle sometimes disposed in two layers (*Fig.* 4). It is not uncommon to see tubes lined partly by glandular epithelium and partly by stratified epithelium, and such an appearance has been fancifully interpreted as representing the gastro-œsophageal junction.

Respiratory tubes are lined by columnar cells, sometimes ciliated, and the resemblance to trachea or bronchi is enhanced by supporting nodules or plates of hyaline cartilage, and by encircling bands of plain muscle (*Fig.* 5).

Certain glandular organs, such as salivary glands, prostate, heart, liver,

and pancreas have all been described, but have not figured in sections from the specimens under consideration, though it is not uncommon to find acini lined by cubical or columnar cells grouped together in a gland-like fashion. *Thyroid tissue* was present in three specimens, reproducing adult and fœtal types, and in another tumour some adenomatous tissue presented a close resemblance to a cystic goitre.

Some of these glandular structures may be epiblastic in origin, e.g., mammary tissue; but probably the majority are hypoblastic, and it is convenient to group them together, though perhaps not always accurate.

3. EPIBLAST.—

Stratified epithelium is the most frequent and striking representative, but is sometimes scanty and hard to find, and may be absent. It assumes varying forms, usually lining cysts, but sometimes forming solid columns or plaques (*Fig.* 6). Typical 'cell-nest' formation is often a striking feature, and in rare cases the keratinized epithelium takes the peculiar form of circular laminæ, aptly compared with the skins of an onion. Cell-nest or epithelial pearl formation, though highly typical of squamous epithelioma elsewhere, appears to be a natural event in the epidermoid cysts of teratoma testis. Reference has already been made

FIG. 5. — *Teratoma* (same specimen): 'Respiratory tube'. Narrow space lined by columnar cells supported by plate of embryonic cartilage. This particular tube was of some length, and had several nodules of cartilage in close relation to it, cartilage being noticeably absent in other parts of the section.

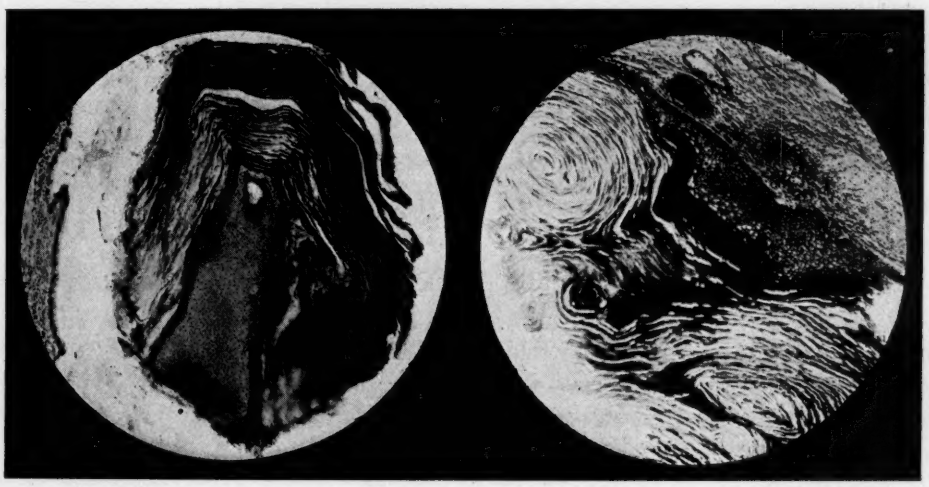

FIG. 6.—*Teratoma* (same specimen): Epiblastic elements. (Left) Rod of stratified epithelium, capped by horny layers, lying in a space lined by columnar cells. (Right) Wall of epidermoid cyst, showing cell nests.

to the existence of cysts lined partly by stratified and partly by cubical or columnar epithelium, and one is inclined to regard this as indicating a partial stratification of the Malpighian layer.

Neuro-epithelium has been observed in several cases, sometimes reproducing the primitive structure of the spinal cord or brain, and scanty groups of ganglion cells have appeared rarely.

Trophoblastic epithelium has not figured in the present group.

Melanotic patches have occurred in several specimens, but this is uncertain ground, and an epiblastic origin cannot be positively assumed.

Teratoma Testis and Malignant Conversion.—It is generally stated that teratoma testis is usually innocent, but may become malignant in virtue of any of its compound elements, and that the resultant tumour may be cancerous or sarcomatous, depending on whether the malignant change affects the connective tissue or epithelial structures. Such a generalization is certainly true, but in the opinion of the writer requires qualification. The testicular teratoma so frequently displays unequivocal signs of malignant change that its essentially malignant character should be more emphatically stressed; in the second place the marked tendency of the epithelial elements, especially the hypoblastic, to assume malignant characters requires greater emphasis.

The *hypoblastic elements*, as observed in the present group, play a more dominant part than either the connective-tissue or squamous epithelial elements in conferring malignant potentialities on these complex tumours, and frequently transform them into carcinomata of different types. Many predominantly carcinomatous tumours of the testis find their precise counterpart in areas of malignant proliferation affecting the glandular structures of teratomata, and if we accept the principle that the overgrowth of the malignant element may lead to partial or complete suppression of the other blastodermic derivatives, the relationship of the teratoma to the pure or almost pure carcinoma of the testis becomes not a hypothesis but a certainty.

No doubt the *connective-tissue elements* occasionally take on a sarcomatous or endotheliomatous structure and sometimes produce purely sarcomatous metastases, and, similarly, the embryonic or adult *epiblastic elements* may assume carcinomatous characters and produce characteristic tumours; but these transformations have not figured with anything like the same frequency in the present series as malignant conversion of the hypoblastic glandular structures.

THE VARIATIONS OF TERATOMA TESTIS.

The specimens described below have been selected with the special object of demonstrating the principle relative to teratoid tumours of the testis that one blastodermic element may overgrow the others, thus producing tumours composed chiefly or entirely of one type of tissue, which may be innocent or malignant. The application of this principle is of far-reaching importance in the interpretation of the great variety of new growths of the testicle, and undoubtedly provides the key to a large part of this field of testicular pathology.

It is proposed to describe: (1) The typical teratoma which can be recognized at once by a glance at the cut surface, and contains representatives of all three layers of the blastoderm; (2) A solid, seemingly homogeneous tumour containing heterologous elements, in order to show that teratoid tumours frequently lack the characteristic 'cystic' appearance; and (3) Specimens illustrating individual variations which can reasonably stand interpretation as one-sided developments of a teratoma. By great good fortune many variations have occurred in the material available and provide a fairly complete series. Though several gaps exist, it does not appear to impose too great a strain on scientific credulity to assume the possible existence of the missing members. A series of sixty specimens is too small to include all types, but reference to the literature readily provides the necessary examples.

The specimens here described fall naturally into the following categories :—

1. *The typical tri-dermal teratoma.*—'Fibrocystic disease' of the older terminology.

2. *The solid, apparently homogeneous tumour containing heterologous elements.*

3 *Mesoblastic overgrowth.*—(*a*) Cartilaginous; (*b*) Myomatous; (*c*) 'Mixed' tumours of myxo-chondro-endotheliomatous type resembling certain parotid tumours.

4. *Hypoblastic overgrowth.**—(*a*) Simple papillary adenofibroma with heterologous elements; (*b*) Adenocarcinoma with heterologous elements; (*c*) Pure adenocarcinoma; (*d*) Spheroidal-celled scirrhous carcinoma.

5. *Epiblastic overgrowth.*—(*a*) Dermoid cysts—so-called; (*b*) Squamous carcinoma (epithelioma); (*c*) Basal-celled carcinoma (rodent cancer); (*d*) Chorion-epithelioma; (*e*) Neuro-epithelial tumours.

Sub-groups (*b*), (*d*), and (*e*) of the fifth category do not occur in the present series, but are mentioned to round off the subject.

Specimen 1.—**The typical three-layered teratoma.**

The tumour was removed from a man, age 26, who had complained of pain in the testis dating from an alleged strain fourteen weeks previously.

Macroscopic.—The specimen is bisected sagittally, the tumour and fused testis together forming a spherical mass a little larger than a golf ball. The epididymis is not involved and appears unduly mobile. The cut surface displays the cystic character of the teratoid tissue to great advantage, and is honeycombed with small pea-like rounded or oval cysts. The body of the testis is readily made out at the upper pole of the tumour, and is separated from the 'cystic tissue' by a definite capsule. The testis is compressed and reduced to the size of a bean, but the cut surface presents the normal characteristic pale granular appearance, and stands out in marked contrast to the cystic teratoid tissue below (***Fig.* 7**).

Microscopic.—The teratoid nature of the tumour is at once evident, and all three blastodermic derivatives are represented, but in varying proportions.

Hypoblastic Elements dominate the picture, and show an advanced degree of development. They appear in the form of glandular spaces lined by columnar cells, many of them being of the goblet or mucigenous variety like those of adult intestinal mucosa. The resemblance to intestine is enhanced by subepithelial aggregations of lymphoid tissue and by encircling bands of plain muscle fibres. Other spaces lined by columnar cells supported by occasional plaques of embryonic hyaline cartilage might stand interpretation as respiratory tubes (*see Fig.* 5).

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* It is possible that some tumours included in this group are of glandular epiblastic origin, but it is convenient to group them together.

Mesoblastic Elements are represented by the fibromyxomatous matrix, by plain muscle bundles, by lymphoid aggregations, and by scanty nodules of embryonic cartilage. In the main the formed mesoblastic elements are decidedly scanty.

Epiblastic Elements are represented by spaces lined by stratified epithelium, and perfect cell-nest formation is a striking feature (*see Fig.* 6). The first section taken from one part of the periphery of the tumour showed a marked preponderance of epidermoid cysts and suggested a diagnosis of squamous epithelioma, while later sections from the rest of the tumour displayed great overgrowth of the hypoblastic elements as described above.

The Testis Proper is disposed chiefly at the upper pole as seen by the naked eye, but a thin film of testicular substance is spread over the greater part of the free surface of the teratoid tissue and is separated from it by a definite fibrous capsule. The arrangement and shape of the seminiferous tubules appear to be normal, and spermatogenesis is evident.

FIG. 7.—*Teratoma testis:* 'Typical fibrocystic disease'. The cut surface is so characteristic that the nature of the tumour is evident at a glance, in contrast to the succeeding figures. The body of the testis is situated at the upper pole of the teratoma, and the epididymis in this case is unusually mobile.

Comment.—The specimen is a perfect example of the typical teratoma testis, and the appearances presented by the cut surface are so characteristic that the diagnosis is evident at a glance. The relationship of the teratoid tissue to the body of the testis and to the epididymis at once suggests that the new growth originated in the mediastinum. The tumour is small, coming to light at a relatively early stage of its development, probably owing to the patient's attention being drawn to the enlargement of the testicle by the injury. No evidence of malignant degeneration of the various blastodermic elements appears in the sections examined, unless the epidermoid cysts are regarded as such; but it would appear that cell-nest formation is to be regarded as a normal development from cysts lined by stratified squamous epithelium. The hypoblastic tubes and spaces present such an unmistakable resemblance to adult intestine that the tumour merits a position in the teratoma category rather than the teratoid.

This highly characteristic three-layered tumour should be regarded as the fundamental type and the basis of the variations described below.

Specimen 2.—**Solid, apparently homogeneous tumour with heterologous elements.**

No history is attached to this specimen, which belongs to the Spence collection.

MACROSCOPIC.—The tumour is the size and shape of a grape-fruit and is bisected sagittally. The cut surface presents all the appearances of a solid homogeneous structure. That the tumour was not homogeneous was first indicated by a gritting sensation on taking pieces for microscopic examination.

MICROSCOPIC.—*Hypoblastic Elements.*—The bulk of the tumour is formed of masses of spheroidal or oat-shaped cells disposed diffusely or in an alveolar fashion and enclosed by septa of fibrous tissue. This malignant tissue stains poorly and for the most part gives little indication of its origin, but in a few of the spaces it is possible to make out a peripheral lining of cubical cells which merge into the oat-shape and suggest an origin from hypoblastic elements. This impression was strengthened by finding in later sections spaces lined by cubical and columnar cells.

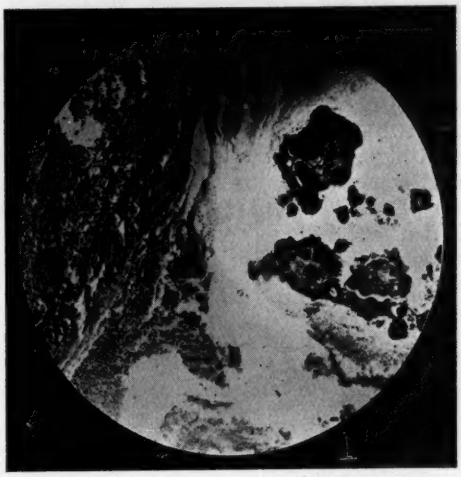

FIG. 8.—*Teratoma:* Showing osteoid tissue.

Mesoblastic Elements.—The striking feature appearing in most sections is the presence of nodules and plates of well-formed bone which appear to be scattered throughout the greater part of the tumour (*Fig.* 8). The arrangement of some of the osteoid tissue gave the impression at first that it might possibly have developed in fibrous septa as the result of metaplasia, but discovery of patches of voluntary muscle and fatty tissue strengthened a teratoid origin.

Epiblastic Elements are not recognizable in any of the sections.

The Testis appears as a peripheral band on the surface of the tumour.

FIG. 9.—*Teratoma testis:* Mesoblastic (chondromatous) overgrowth. Cartilage is particularly evident at the lower pole in the photograph, though to the naked eye it is abundant throughout the cut surface.

Comment.—The specimen clearly belongs to the teratoid group, and is interesting as showing the complex nature of an apparently solid homogeneous tumour. Some of the sections showed only the malignant cellular tissue, and in the absence of further examination and the clue afforded by the gritting observed in taking the first piece for histological examination, the teratoid nature of the specimen might have escaped notice. It is a commonplace in the literature of testicular tumours to find that re-examination reveals the presence of heterologous elements in cases hitherto regarded as purely sarcomatous or carcinomatous—a sure indication of the futility of depending on the examination of a small piece from one part.

Specimen 3.—**Mesoblastic overgrowth: (*a*) Cartilaginous.**

No history is attached to this specimen, which belongs to the Spence collection.

MACROSCOPIC.—Only one half is preserved, and indicates that the tumour was the size of a small melon. The cut surface presents a striking resemblance to that of an ordinary

chondroma, and is studded with pearly cartilaginous nodules ranging in size from a small bead to a bean or cherry. Several of the larger nodules show central cystic degeneration. Towards the lower pole the surface appears entirely cartilaginous (*Fig.* 9), but elsewhere the cartilaginous islets are supported by strands of fibrous tissue which is nowhere abundant except near the upper pole. Several small isolated cysts are present. The remains of the testis are not visible to the naked eye.

MICROSCOPIC.—*Mesoblastic Elements.*—The striking feature in sections taken from different areas is the presence of numerous nodules of well-developed hyaline cartilage. These constitute the greater bulk of the tumour, and are surrounded and separated from each other by a small amount of fibrous tissue and occasionally by plain muscle-fibres. Myxomatous degeneration is evident in some of the nodules, but the cartilage cells appear to be circumscribed and do not invade the fibrous tissue. In addition to the obvious well-developed cartilaginous islets there are in some areas enormous numbers of tiny nodules containing only a few cartilage cells (*Fig.* 10).

Further evidence of the predominance of the mesoblastic element in this tumour is provided by scattered cylindrical cross-striped muscle fibres and globular sarcoblasts, while towards the upper pole there is a considerable amount of fibrous tissue.

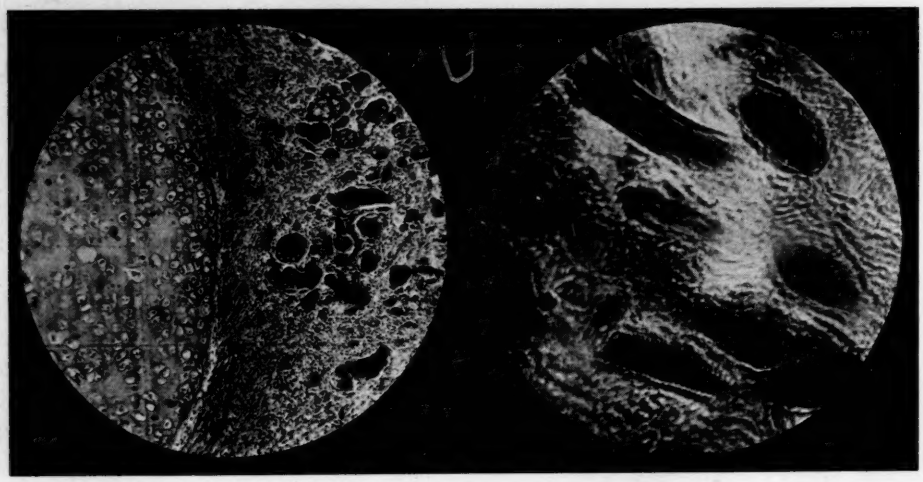

FIG. 10.—*Teratoma :* Cartilaginous overgrowth. (Left) Showing nodules of cartilage, large and small, which make up the bulk of this tumour. (Right) Showing patch of striped muscle.

Hypoblastic and Epiblastic Elements.—At first sight it appeared likely that these elements had been entirely suppressed, for though scanty cystic spaces were observed which by analogy with appearances seen in other teratoid tumours might be taken to represent glandular spaces, conclusive evidence of the existence of other blastodermic derivatives was obtained only by the discovery of one large space lined by columnar cells, assuming a pavement form at one part.

The Testis is present at the periphery of the tumour in the form of a few compressed and atrophied tubules.

Comment.—The specimen is a teratoma and is a fine example of the 'chondroma testis' of the older terminology. It illustrates a remarkable overgrowth of the mesoblastic element, hyaline cartilage predominating. The importance of this type of tumour lies in the fact that it establishes the principle of the overgrowth in teratoid tumours of one blastodermic derivative at the

expense of the others—a principle which beyond doubt has a wide application in the interpretation of testicular new growths.

It is a matter of great importance in this connection to demonstrate the existence of other blastodermic derivatives in tumours composed almost entirely of mesoblast, to exclude an origin by a process of metaplasia from the mesoblastic tissue constituting the fibrovascular matrix of the testis proper. Virchow in particular allotted great scope to the influence of metaplasia in the production of complex tumours of the testis, but a teratomatous origin appears certain if the presence of characteristic elements derived from one or both the other blastodermic layers is established.

Paget's classical case of enchondroma testis, described in 1855, throws an interesting light on the phases of interpretation through which a complex tumour may pass. It was regarded originally by Paget as a malignant cartilaginous tumour producing metastasis in the lung by invasion of the spermatic veins, but later investigation by Kanthack and Pigg demonstrated the presence of columnar-celled elements, and the tumour was then looked upon as a columnar-celled cancer with cartilaginous formation in the stroma. Further investigation by Nicholson showed the existence of epithelial pearls in both the primary and secondary growths, thus establishing the existence of representatives of all three layers of the blastoderm and conclusively proving the teratoid nature. The pulmonary growth may be regarded in the light of a transplantation through the venous system rather than an evidence of malignancy.

FIG. 11.—*Teratoma testis:* Mesoblastic (myomatous) overgrowth. The cut surface gives some indication of the composition of this tumour.

***Specimen* 4.—Mesoblastic overgrowth: (*b*) Myomatous.**

No history is attached to this specimen, which belongs to the Spence collection, and the one half preserved suggests that the complete tumour was the size of a small melon.

MACROSCOPIC.—The cut surface gives some indication of the predominating myomatous nature of the tumour, and is fleshy and firm, and pale pink in colour over the greater part, with here and there granular areas suggesting a glandular structure (*Fig.* 11).

MICROSCOPIC.—*Mesoblastic Elements.*—Numerous sections taken from various parts present the same structure. The tumour is formed almost entirely of a combination of plain and striped muscle fibres, disposed diffusely or in alveoli. Sections stained by van Gieson's method display an alveolar arrangement, the muscle fibres and cells being supported by a moderate amount of fibrous tissue.

The plain muscle calls for no comment, and its arrangement recalls that of

myoma uteri. The striped muscle appears in various stages of development, and it is noteworthy that typical adult cylindrical fibres are not present in the sections examined. The developing fibres or sarcoblasts appear as pear-shaped or globular

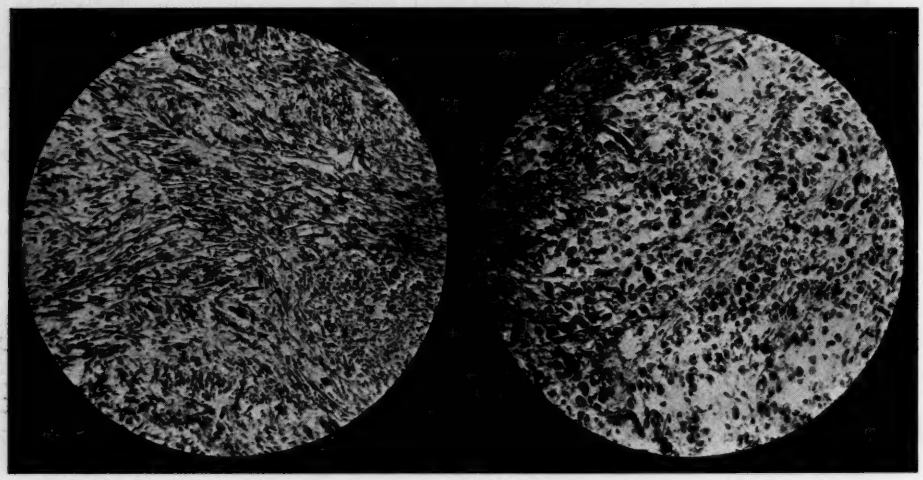

FIG. 12.—*Teratoma :* Myomatous overgrowth. (Left) Resembling ordinary myoma, but some of the spindle cells are striated, and the scanty, larger, dark, fusiform cells are developing striped fibres. (Right) Showing large numbers of globular sarcoblasts, some of which are becoming pyriform.

cells with large nuclei. Some of the sarcoblasts are transversely striated and show transition into thick fusiform striated cells (*Figs.* 12 and 13). Certain elongated spindle-cells closely resembling plain muscle-fibres occur here and there and show striation, and the appearance suggests that plain fibres may become striated. This point has been noted by other observers.

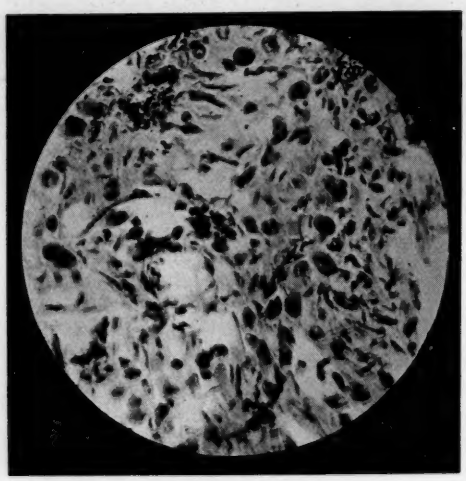

FIG. 13.—High-power view of *Fig.* 12, showing the characters of the sarcoblasts.

Hypoblastic and Epiblastic Elements.—None can be distinguished with certainty, but clear spaces with a definite outline occur in various parts, and, as the specimen is old, may represent glandular spaces out of which the epithelium has been shed ; consequently one would be unwilling to affirm the absence of other than mesoblastic elements in the tumour.

Testis.—No trace of the testicle appears in the various sections.

Comment.—The specimen, so far as the examination of the available half is concerned, demonstrates a remarkable overgrowth of the muscle element and merits the name rhabdomyoma or rhabdo-leio-myoma. It seems highly probable that it has arisen from an overgrowth of the mesoblastic elements of a teratoma, and though this cannot be positively assumed, analogies presented by other one-sided developments of teratoma

testis give reasonable justification for including it in the teratoid category. Further support to the teratoid origin is afforded by the fact that other observers have demonstrated epithelial and cartilaginous structures in tumours of this type. Rokitansky's classical case of a rhabdomyoma attached to the lower pole of the testis is generally regarded, on the other hand, as a tumour derived from the muscular tissue of the gubernaculum.

Specimen 5.—**Mesoblastic overgrowth: (c) The 'mixed' tumour.**

For the purpose of this paper this term is restricted to the rare tumours of the myxo-chondro-endotheliomatous type presenting a close resemblance to certain tumours of the parotid, though it should be stated that salivary-gland tumours of this variety are regarded by some pathologists as myxo-chondro-carcinoma and not as endothelioma. Two occur in the present series and merit a brief description. Both are old specimens in a poor state of preservation, but the sections are sufficiently good to display the main structural points. *Fibrous and myxomatous tissue* predominate, accounting for the poor staining. The *endothelium* of the vascular spaces is unduly prominent and shows patchy proliferation. In some areas the swelling of the endothelial cells produces a spurious adenomatous appearance, in others the cells are arranged in the form of anastomosing cords, and in others again the endothelial proliferation is so diffuse as to produce solid cellular sheets. Areas of degenerating myxomatous *cartilage* are present in the one tumour, but the other shows merely a *myxo-fibro-endotheliomatous structure* (*Fig.* 14). Both resemble degenerating salivary tumours in the disappointing quality of the sections.

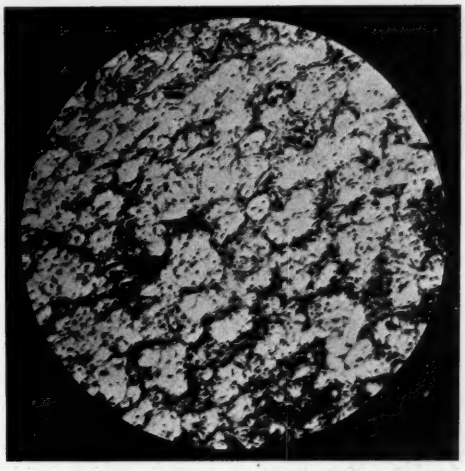

FIG. 14.—*Teratoma:* Myxo-chondro-endothelioma type resembling certain parotid tumours. Interlacing framework of darkly staining endothelial (?) cells surrounding and merging into myxomatous areas, in some of which degenerated cartilage is present.

Comment.—Tumours of this simple type apparently composed of purely mesoblastic tissues may originate from:—

1. An overgrowth of the mesoblastic elements of a teratoma.
2. An overgrowth of the fibrovascular stroma of the testis proper with cartilaginous metaplasia.

From a consideration of the present specimens the writer inclines to the teratoid origin, because the remains of the testis can be seen at the periphery of one of the tumours, but more especially because a similar structure is often seen in patchy distribution in undoubted teratomata. From the practical point of view they can be regarded as among the most innocent of testicular tumours, and do not recur after castration. Parotid tumours, on the other hand, treated by enucleation, may recur from outlying portions left *in situ*.

Specimen 6.—**Hypoblastic overgrowth: (a) Simple papillary adenofibroma with mixed elements.**

No history is attached to this tumour, which is preserved in the Anatomical Museum, and is described as probably sarcomatous.

MACROSCOPIC.—The specimen is the size of a grape-fruit, and has been partially

split in the sagittal direction and spread out in front of the cord and epididymis. The body of the testis is indistinguishable. The cut surface is homogeneous and is divided into a number of large lobules by deep branching furrows, the whole appearance recalling the cut surface of certain fibro-adenomata of the breast, or of certain myxomata (*Fig.* 15).

FIG. 15.—*Teratoma testis :* Adeno-myxo-fibroma. The lobulated cut surface recalls certain adenomata of the breast.

MICROSCOPIC.—The bulk of the tumour is composed of adenofibromatous tissue which resembles nothing so much as a mammary proliferous or papillary fibro-adenoma (*Fig.* 16). The papillary arrangement is readily made out, though many of the slender processes appear in cross-section. The processes are covered by flattened or cubical epithelium supported by a fibro-myxomatous core, the fibrous tissue being scanty in the main though abundant here and there. No evidence of malignancy appears in any of the sections.

Sections from the periphery show mixed elements in the shape of islets of cartilage and myxomatous areas. No trace of the testis occurs in sections examined.

Comment.—This tumour illustrates a rare type which is certainly best interpreted as a variation of teratoma testis, the predominant adenomatous tissue representing a simple overgrowth of the glandular elements, while the mixed elements at the periphery composed of mesoblastic derivatives confirm the essential teratoid origin. The precise nature of the glandular element which by its overgrowth has produced the bulk of the tumour remains uncertain, but the resemblance to the proliferous mammary tumour is suggestive, and it is interesting to recall that adenofibromatous tumours of the breast in rare cases contain mixed elements. On the other hand, any adenomatous tissue may develop papillary projections. Papillary adenomatous tumours of the testis have been recorded very rarely in the literature, and the above example came as a surprise, though perhaps the peculiar lobulation of the cut surface should have afforded a clue.

FIG. 16.—*Teratoma :* Papillary myxo-adeno-fibroma, resembling certain mammary tumours.

Specimen 7.—**Hypoblastic overgrowth: (*b*) Adenocarcinoma with heterologous elements.**

The specimen was removed from a patient, age 26, who had complained of pain and swelling of the testicle for ten weeks.

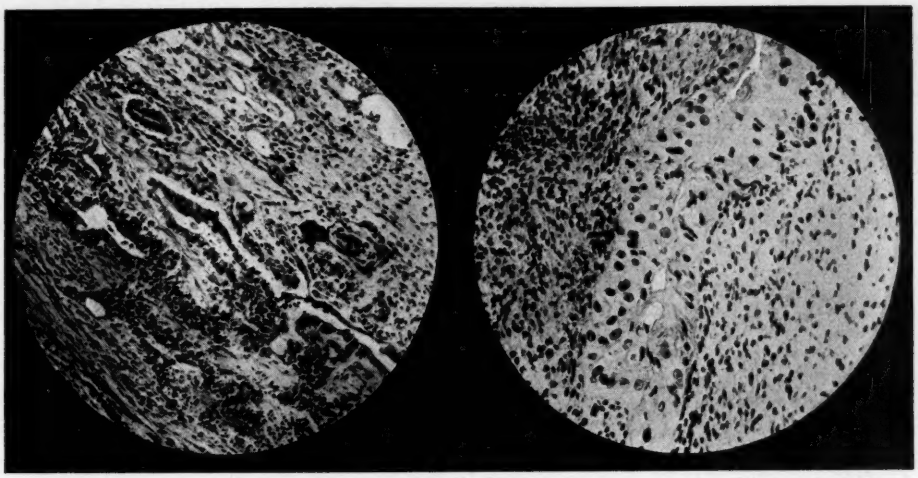

FIG. 17.—*Teratoma:* (Left) Adenocarcinoma. (Right) Space lined by stratified epithelium surrounded by abundant myxofibromatous stroma.

MACROSCOPIC.—The tumour is the size of an orange and is bisected. The cut surface appears homogeneous in the main, but here and there cystic formation occurs on a small scale, but is not sufficiently evident to suggest 'cystic disease'. The epididymis is not involved and is spread over the posterior surface.

FIG. 18.—*Teratoma* (same tumour): Papillary adenocarcinoma. This should be compared with *Fig.* 16, of which it appears to be the malignant version.

MICROSCOPIC.—The specimen is remarkable for the histological variations presented, but in the main is an adenocarcinoma supported by a fibromyxomatous matrix.

Hypoblastic Elements. — Numerous tubules and spaces lined by cubical and columnar cells predominate. Some are clearly innocent, but the majority present the features of an active adenocarcinoma (*Fig.* 17). In some areas the infiltrating glandular cells assume a spindle shape, and being massed together give an appearance like a spindle-celled sarcoma. In several areas the cystic spaces are dilated and lined by flattened or cubical cells, and the appearances are strongly reminiscent of a simple cystic goitre. In other areas the glandular tissue assumes an infiltrating malignant papillary formation, and cross-sections of papillæ yield a spurious peritheliomatous appearance. This malignant papillary tissue is most aptly compared with the features seen in some malignant papillomatous ovarian tumours (*Fig.* 18).

Epiblastic Elements.—These are decidedly scanty, but appear in the form of

spaces lined by stratified epithelium and of scattered patches of pavement epithelium. No cell nests are detectable.

Mesoblastic Elements.—There is an abundant fibromyxomatous matrix which in some areas appears sarcomatous, though a sarcomatous appearance is certainly produced by the infiltrating glandular cells taking on a spindle shape. Myxo-endotheliomatous areas are occasionally abundant. No cartilage or other formed mesoblastic elements appear in any of the sections.

The Testis is readily recognizable as a flattened band at the surface of the tumour.

Comment.—The specimen is a teratoma, hypoblastic elements predominating and undergoing malignant degeneration, transforming the tumour into an adenocarcinoma. Epiblastic elements are scanty, but help to establish the teratoid nature, and link this specimen up with the next. Specimens of this type illustrate the important fact that teratoid tumours exhibit various gradations between the typical tumour containing all three blastodermic elements and those formed apparently entirely of one element.

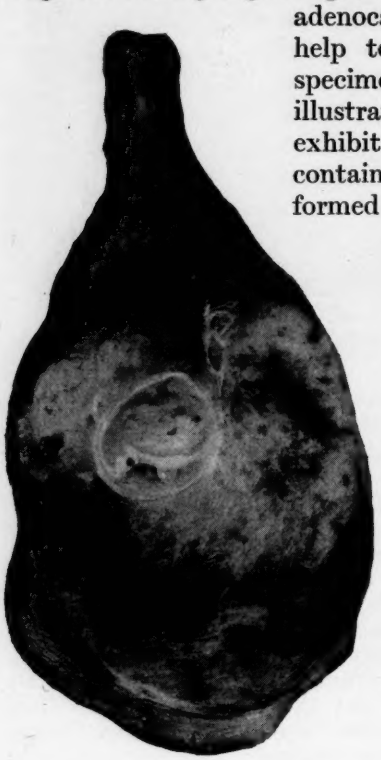

FIG. 19.—*Teratoma testis:* Hypoblastic (adenocarcinomatous) overgrowth. The cut surface is of 'medullary' type, with hæmorrhages. The testis is not visible to the naked eye but persists microscopically as a peripheral band. The epididymis is fused.

FIG. 20.—*Teratoma:* Cylindrical or columnar adenocarcinoma, showing spaces from which the tumour has arisen.

Specimen 8.—**Hypoblastic overgrowth: (*c*) Pure adenocarcinoma.**

This specimen was removed from a man, age 42, who gave a six months' history of swelling of the testicle with recent enlargement of the inguinal glands.

MACROSCOPIC.—One half is preserved, the complete tumour being the size of a small melon. The cut surface presents a brain-like appearance with several circumscribed paler nodules, and there are numerous small hæmorrhages throughout the tumour substance. There is a small hæmatocele at the upper pole, and the lower part of the tunica vaginalis is obliterated by the adhesion of the tumour to the scrotum, which probably accounts for the inguinal metastases. The epididymis is fused and indistinguishable (*Fig.* 19).

MICROSCOPIC.—*Hypoblastic Elements.*—The tumour is a vascular adenocarcinoma derived from columnar cells and supported by a scanty fibrous stroma (*Fig.* 20).

The columnar or cylindrical-celled character is displayed to great advantage in the cells lining the spaces and in the cross-sections of the papillæ, which show the cylindrical cells arranged around a fibrovascular core. Considerable areas of new growth have undergone degeneration and hæmorrhagic infiltration and stain poorly. Glandular spaces lined by columnar cells retaining a simple character appear on the surface of parts of the tumour, show a transition into cancer, and may certainly be regarded as the starting points of the cancer.

Epiblastic and Mesoblastic Elements do not appear in the sections examined.

The Testis.—The degenerated remains of the testis can be recognized as a peripheral band at the surface of the tumour.

Comment.—The specimen is to be regarded as a glandular carcinoma derived from the hypoblastic elements of a teratoma with suppression of the other blastodermic derivatives, though of course it is possible that further sections might reveal traces of the other layers. The essential fact, however, is that the tumour is predominantly an adenocarcinoma of a structure sometimes exactly duplicated in indubitable teratoid tumours by malignant conversion of the hypoblastic elements.

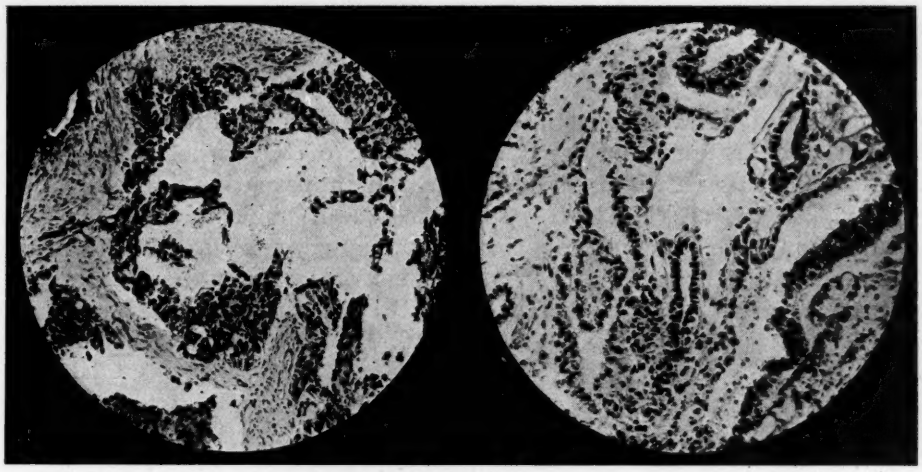

FIG. 21.—*Teratoma:* (Left) Spheroidal-celled cancer of scirrhous type. (Right) Columnar-celled glandular elements giving origin to the cancer.

Specimen 9.—**Hypoblastic overgrowth: (*d*) Spheroidal-celled scirrhous carcinoma.**

Spheroidal-celled carcinoma is sometimes regarded as a special type, and consequently a short description of the following typical example appears warranted. By some it is related to a specially early age incidence—26·3 years (Schultz and Eisendrath)—and the present case happens to conform to this.

T. W., age 27. Swelling of the left testicle noticed for four months. It steadily grew, and on admission to hospital the tumour had reached the size of the fœtal head, fungated through the scrotum, and involved the left inguinal glands. In spite of an extensive removal of tumour, scrotum, and glands, the patient returned in five months with large metastatic tumours in the upper abdomen.

MACROSCOPIC.—The cut surface is of the 'medullary' type, and the epididymis is incorporated and indistinguishable.

MICROSCOPIC.—The bulk of the tissue examined presents the typical appearances of spheroidal-celled cancer, with here and there indications of the glandular elements giving rise to the tumour (*Fig.* 21). Parts of the neoplasm are scirrhous,

and scanty epithelial cell-groups are separated by a considerable amount of fibrous tissue, but other areas are encephaloid. Earlier sections showed the spheroidal type of cell almost entirely, and the invasion of the inguinal glands has the same character, but later sections demonstrated abundant areas of columnar-celled adenocarcinoma and simple glandular spaces, and indicated the origin of the spheroidal elements. In addition there are some large spaces lined by cubical or columnar cells, which contain deeply staining colloid material and resemble thyroid tissue.

Comment.—The tumour is a carcinoma, spheroidal-celled elements predominating, and arising from an overgrowth of hypoblastic derivatives. Its teratoid origin is indicated by the mixed glandular characters and by the existence of a peripheral band of degenerated testicular substance. The brief duration and comparatively large size of this tumour, in common with the two preceding specimens, should be noted as indicating the high degree of malignancy and rapid course of the teratoid glandular cancer.

TERATOID CARCINOMA OF GLANDULAR ORIGIN, PROBABLY HYPOBLASTIC.

This group has already been partly considered in a previous section and its wide scope indicated. All that is necessary here is to elaborate the carcinomatous conversion of the hypoblastic elements of teratoid tumours and to indicate the relations of this group to the specific germinal-celled tumours to be described later. Examination of a large number of teratoid tumours demonstrates the numerous variations in type of the hypoblastic elements, and often reveals early cancerous change in apparently innocent tumours (*Figs.* 22, 23, 24, and 25). In many cases the hypoblastic origin is readily traced, but in others it is possible that the malignant transformation has begun in glandular structures of epiblastic derivation—mammary tissue, for example. Consequently it is safer to speak of teratoid carcinoma of glandular epithelial origin, though in the majority of cases it is the hypoblastic structures which are at fault.

Types of Carcinoma.—It is traditional to describe carcinomatous tumours of the testis according to the character of the cells and their arrangement. Thus, cancers are described as columnar-celled, spheroidal-celled, alveolar, scirrhous, and encephaloid. Little importance should be attached to these sub-divisions, for though a testicular tumour may be predominantly spheroidal-celled, cubical or columnar elements are usually demonstrable, and as in the breast, for example, parts of a tumour may be scirrhous and others encephaloid. This method of grouping, though artificial and having no special histological significance, has the merit of convenience. The following types of teratoid carcinoma of glandular and probably hypoblastic origin may be distinguished, but are frequently merged: (1) *Columnar- or cylindrical-celled cancer;* (2) *Spheroidal-celled cancer;* (3) *Undifferentiated more or less round-celled cancer.*

Columnar-celled Cancer.—This is a frequent type, and the examples appearing in the present series reproduce all the features of adenocarcinoma as observed in other parts of the body. Though it may appear in pure form as the result of one-sided overgrowth, the facts that similar glandular elements are seen characteristically in teratoid tumours, and that some specimens contain mixed elements, seem incontrovertible evidence of its essential teratoid nature.

SPHEROIDAL-CELLED CANCER.—This is also a fairly common type, and for the same reasons is generally regarded as arising from the epithelial elements of a teratoma, and its accredited early age incidence in the twenties supports

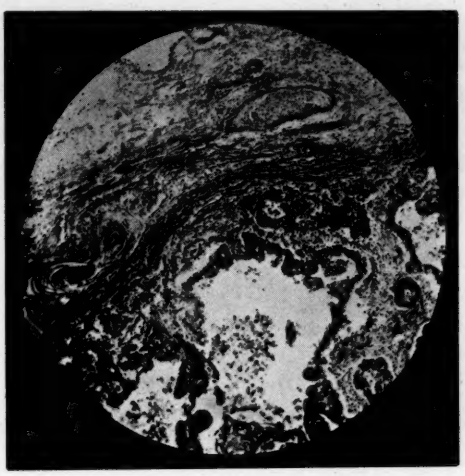

FIG. 22.—*Teratoma :* Carcinomatous transformation of glandular elements, with two nodules of stratified epithelium.

FIG. 23.—*Teratoma :* Carcinomatous transformation of glandular elements. Other portions of section show simple spaces lined by cubical cells, also stratified epithelium and cell nests.

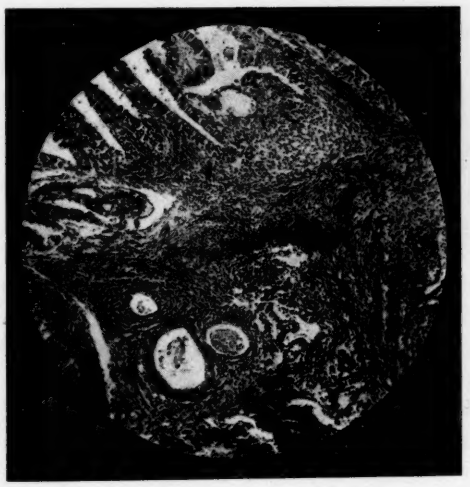

FIG. 24.—*Teratoma :* Carcinomatous transformation of glandular elements. Near centre, spaces lined by columnar cells which in other parts are infiltrating the stroma.

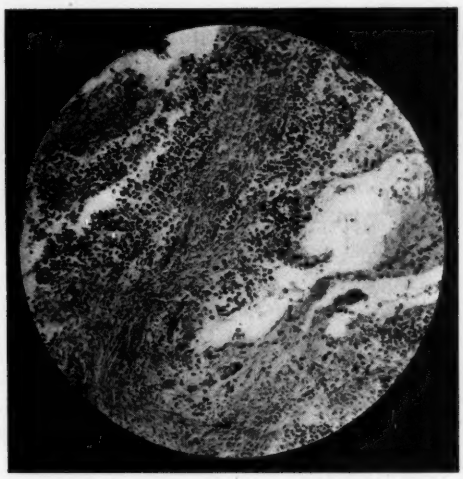

FIG. 25.—*Teratoma :* Carcinomatous transformation of glandular elements. An undifferentiated round-celled type of carcinoma, resembling sarcoma and spermatocytoma, but definitely originating from spaces lined by cubical cells as seen in other parts of the tumour.

this view. It reproduces exactly the features of spheroidal-celled cancer as observed in the breast and other organs.

UNDIFFERENTIATED ROUND-CELLED CANCER.—It is not uncommon to observe in teratoid tumours areas of round-celled cancer closely resembling sarcoma and yet arising undoubtedly from glandular tubes or spaces (*Fig.* 25). This presumably is a proliferation of cells of an embryonal type which lose all differentiation. The recognition of this variety is obviously important, as it may resemble the specific tumours of germinal-celled origin and is likely to be confounded with them.

As far as can be judged from the present group of teratoid tumours, this type of carcinoma has appeared only in a patchy form, and an origin from glandular spaces of an embryonal character has been readily traced, if not in the same section, in others taken from the same tumour. Yet, if we allow full scope to the principle that a one-sided overgrowth often occurs in teratoid tumours and that such overgrowth is more frequent in the embryonal elements, it would seem highly probable that pure or almost pure embryonal carcinomata of teratoid origin may occur from time to time. Such a cancer would closely resemble the germinal-celled tumours to be described in a second paper, and in the absence of mixed elements might be extremely difficult to differentiate from them.

EPIBLASTIC OVERGROWTH.

The Teratomatous Cyst (Dermoid Cyst) of the Testis.—The testicular 'dermoid', as might be expected, presents general resemblances to the better-known ovarian dermoid cyst, with the remarkable difference that it is so rare that only some half-dozen cases have been recorded in Great Britain within recent times. The pioneer work of Verneuil[4] probably accounts for the more frequent reference to it in French literature. The writer has met with only one example from the human subject in the Edinburgh collections. On the other hand, the dermoid is a comparatively common tumour in the ovary, while the polycystic teratoma is rare if the common multilocular cystadenoma is excluded from the teratoid category.

No satisfactory explanation of this curious reversal of the incidence of the two types in the testis and ovary is forthcoming, though it is well known that the epiblastic elements are relatively better represented in the ovarian teratomata. Nicholson[5] relates it to the difference in pressure exerted upon the developing tumour in the seminiferous tubule and in the Graafian follicle. In the former, pressure limits development and causes irregular growth, and the resultant tumour is of the small polycystic variety, while in the Graafian follicle the comparative absence of pressure allows greater development, and the single cyst predominates and may attain considerable dimensions. Both testis and ovary, however, produce intermediate types or links between the typical dermoid and the polycystic teratoma, and Barrington[6] reports a tumour of the testis in which a dermoid cyst representing the epiblastic elements was associated with a solid carcinoma evidently derived from columnar hypoblastic elements.

The term 'dermoid cyst' of the testis should be discarded, as it indicates only the striking and obvious feature, and gives no indication that the cyst is really a localized epiblastic overgrowth of a teratoma, as the co-existence of mixed elements and the occurrence of intermediate types conclusively

proves. Furthermore, it may lead to confusion with the skin dermoids that occasionally develop in the median raphé of the scrotum and have no relation to the testis proper.

Two examples are here described. The first, which is preserved in the Museum of the Edinburgh Royal College of Surgeons, I owe to the courtesy of C. W. Macgillivray, who removed it from a patient, age 25, in the Royal Infirmary, Edinburgh. The second, a cyst of the testis of a horse, is preserved in the University Anatomical Museum, and is briefly described for a special reason.

Teratomatous cysts of the human testis are so rare that no apology is needed for describing the present highly typical example. The *clinical history* is graphically given in Mr. Macgillivray's own words, and illustrates certain characteristic points discussed below :—

FIG. 26.—*Teratoma testis :* Epiblastic overgrowth. Teratomatous (dermoid) cyst surrounded by testicular substance and containing sebaceous material enmeshing hair. The fœtal rudiment is best seen in the left half.

Specimen 10.—" A. W., 25, single, fisherman. Left testicle unduly large since birth. Indeed, the mother of the patient used to encourage neighbours to come and see it as a curious sight. It 'grew as he grew', and gave him no trouble except for its being large. At the age of three he was taken to the Children's Hospital about it, and his mother was told to bring him back next day, which she did not do. Has had gonorrhœa and sores on the penis. Came to the Royal Infirmary, Edinburgh, in June, 1900, to seek advice because he contemplated matrimony. The left testicle was as large as a man's fist. Dermoid cyst excised, June 13. Discharged cured June 27, 1900."

MACROSCOPIC.—The testicle and enclosed cyst form an ovoid tumour the size of the fœtal head. The testicular substance appears to be increased in amount, and is disposed as a thick peripheral layer completely surrounding the cyst, and the epididymis is stretched over it. The tunicæ albuginea and vaginalis are closely

apposed and in part adherent. The wall of the cyst is slightly pigmented and obviously of the nature of skin, and is covered with hair embedded in a mass of fatty or sebaceous material. The fœtal protuberance (Rokitansky's rudiment) appears as a large projection in its lower part, and no teeth are present (*Fig.* 26).

MICROSCOPIC.—The cyst wall examined is of the nature of fully-developed skin, with hair, sebaceous, and sweat follicles (*Fig.* 27). Resort has been had to the X rays to demonstrate the existence of mixed elements in the form of bone in relation to the fœtal rudiment (*Fig.* 28).

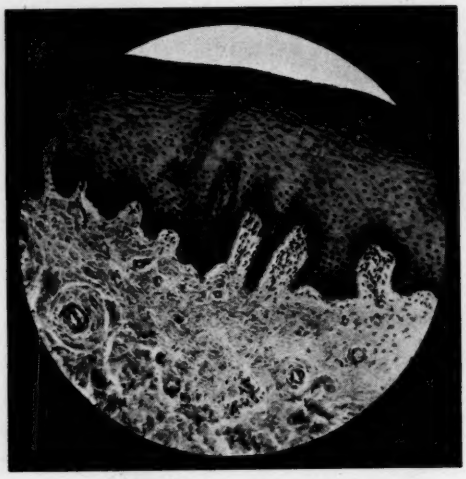

FIG. 27.—*Teratoma:* Epiblastic overgrowth. Wall of teratomatous cyst near fœtal rudiment, showing skin structure.

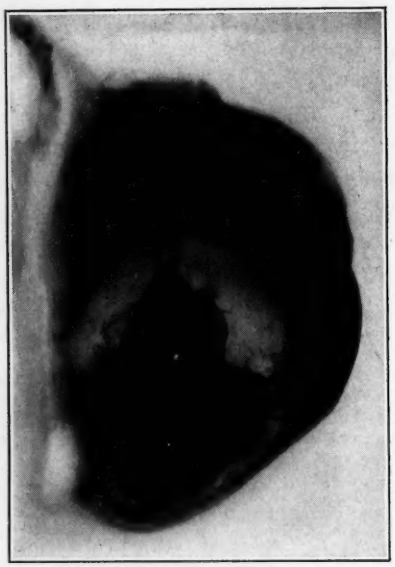

FIG. 28.—Skiagram of left half of same specimen, showing irregular pieces of bone beneath the fœtal rudiment. The right half contained no bone and is not reproduced.

Comment.—This tumour illustrates the following points relative to the teratomatous testicular cyst, and these are shortly compared with those exhibited by the corresponding tumour of the ovary.

1. The tumour is congenital and is present at birth, a feature exhibited by nearly all the recorded cases, as Bland-Sutton[7] points out. The tissues of the teratoma in this case are coeval with those of the host and attain full development, while the less developed teratoid tumours probably arise later in life and their tissues remain more or less embryonal. The ovarian cyst, owing to its concealed position, usually escapes notice till after puberty, and the patient commonly appears for operation between the ages of twenty and thirty.

2. It conforms in every essential detail with the gross structural features of the ovarian tumour, the cyst appearing in the midst of the testis and expanding it in the form of a peripheral capsule as growth advances and the skin secretions accumulate and the hair grows.

3. The tumour 'grew as he grew', causing inconvenience only by its bulk, and showing no signs of malignancy clinically or histologically. The more adult the structure of a teratoma the less prone is it to malignant change,

but malignant conversion of the skin elements has been recorded rarely in connection with the ovarian teratomatous cyst and indicates the narrow line between the simple and the malignant in teratoid tumours of the sex glands.

4. The fœtal rudiment displays no teeth, so often seen in the ovarian tumour, but this accords with the relatively poorer epiblastic representation in teratoma testis generally.

5. The fœtal rudiment has related to it bony structures, indicating the essential multiple-layered nature of the tumour. The ovarian cyst is well known to have aggregated beneath the fœtal rudiment a collection of mixed tissues such as cartilage, bone—often bearing teeth—muscle, and nervous elements; and by analogy we may reasonably assume their existence in the testicular cyst. In any case the presence of bone is indubitable, establishing the essential teratoid nature of the so-called dermoid, which the presence of the striking skin-lined, hair-clad cyst is apt to dwarf.

Specimen 11.—**Multilocular teratomatous cyst of horse's testis.**

No history is attached.

Macroscopic.—The testis and enclosed cysts form a tumour the size of a large orange which is split sagittally and folded apart. This makes it difficult to say exactly how many skin-lined cysts are present, but there is certainly a large central one, and two (probably three) smaller ones lying more peripherally. The large cyst is the size of a small egg, and shows at one part a small projection or fœtal rudiment overlying a mass of hard bone, and all display tufts of coarse hair resembling mane or tail. Again, no teeth are present. A small amount of sebaceous material is embedded in the roots of the hair (*Fig.* 29).

The testis is massed chiefly at the upper pole, but exists all round as a circular layer enclosing the cysts. The epididymis is spread over the back of the tumour.

Microscopic.—The lining of the cysts is of the nature of well-formed skin displaying the usual appendages. The existence of mixed elements in the form of masses of bone is evident at a glance, and is demonstrated by a skiagram (*Fig.* 30). The testicular substance is normal as regards the number and shape of the seminiferous tubules, but the cells are degenerated, probably owing to the formalin fixation.

Fig. 29.—*Teratoma testis* (*horse*): Epiblastic overgrowth. Multilocular dermoid cyst, showing skin-lined cysts and tufts of hair resembling mane or tail. A crescent of bone is seen in the centre, and the testicular substance appears chiefly at the upper pole.

Comment.—The specimen is obviously a teratoma, as the presence of mixed elements indicates, and is an example of overgrowth of the epiblastic elements reaching a high stage of development. Bland-Sutton states that teratomatous cysts of the testis are not uncommon in the horse. The teratomatous cyst is typically single, and this specimen has been described

because the skin-lined cysts are multiple. This type may be regarded as a link in the chain between the highly developed single-cysted variety (teratoma) and the less developed multiple-layered tumour (teratoid).

Multilocular dermoid cysts of the ovary have been occasionally recorded, and presumably indicate a development from more than one germinal cell, resulting in the production of several abortive embryos. This would appear to be true of the fully-developed cyst with other structures in close relation to it, but any epidermoid cyst as seen so often in the simpler teratoid tumours might attain full development, without any limit to multiplicity, yet arising from a single germinal cell.

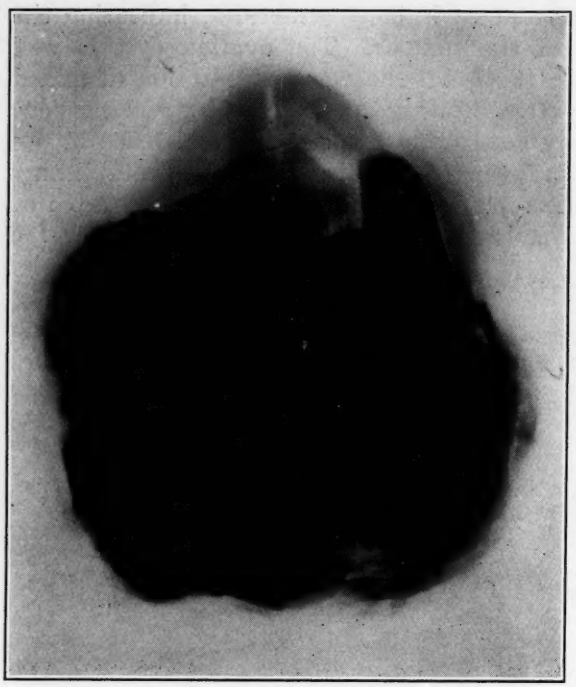

FIG. 30.—Skiagram of specimen *Fig.* 29, showing masses of dense bone in relation to the skin-lined cysts.

Specimen 12.—**Epiblastic overgrowth: Basal-celled carcinoma.**

No history is attached to this specimen, which belongs to the Spence collection and is labelled a fibrosarcoma.

MACROSCOPIC.—The tumour is bisected and is the size of a grape-fruit. The cut surface presents a solid or even fibrous appearance and is divided into lobules by broad fibrous septa in which the cut ends of numerous vessels are visible—in short, a surface inspection suggests that the condition is fibrous or fibrosarcomatous. The epididymis is not involved.

MICROSCOPIC.—The first section showed almost entirely the features of a fibroma or fibrosarcoma and appeared to bear out the existing diagnosis. There were, however, scanty groups of darkly stained small spindle or columnar cells displaying an alveolar arrangement and suggesting epithelial structures. Later sections revealed the significance of these, and demonstrated the presence of a basal-celled carcinoma resembling rodent cancer (*Fig.* 31). Sections taken from superficial areas show a covering peripheral band of testicular tissue separated by a capsule from the underlying characteristic irregular masses of basal-celled cancer, which are supported by a large amount of fibrous or even fibrosarcomatous tissue. At the periphery of the cancerous groups the cells are arranged in the form of spindles of a definitely columnar appearance, giving a superficial resemblance to columnar-celled cancer, while the central cells are mostly oval. A characteristic feature displayed by the cancerous masses is the presence of numerous vacuoles bound by columnar or spindle cells. This is the resu t of mucous or myxomatous degeneration, and produces a spurious adenomatous appearance, to which the term 'reticulated epithelioma' is sometimes applied. Further from the surface the cancer cells are less numerous, and the supporting embryonal fibrous (sarcomatous ?) matrix becomes so abundant that in some fields it is the sole tissue represented. It is interesting to observe in places that the spindle or oval epiblastic cells merge into, and appear to take part in, the formation of the stroma.

As in basal-celled cancer of the skin, horny changes and cell-nest formations are absent.

Comment.—The tumour is a basal-celled carcinoma reproducing the features of typical rodent cancer, and the abundance of the embryonal fibrous tissue suggests that we may be dealing with a combined tumour of epiblastic and mesoblastic origin. No clue is given to the origin of the carcinoma, but it probably arises from the epiblastic elements of a teratoma, the fibrosarcomatous (?) tissue representing mesoblastic elements. The existence of a peripheral band of testicular tissue goes to confirm the teratoid nature.

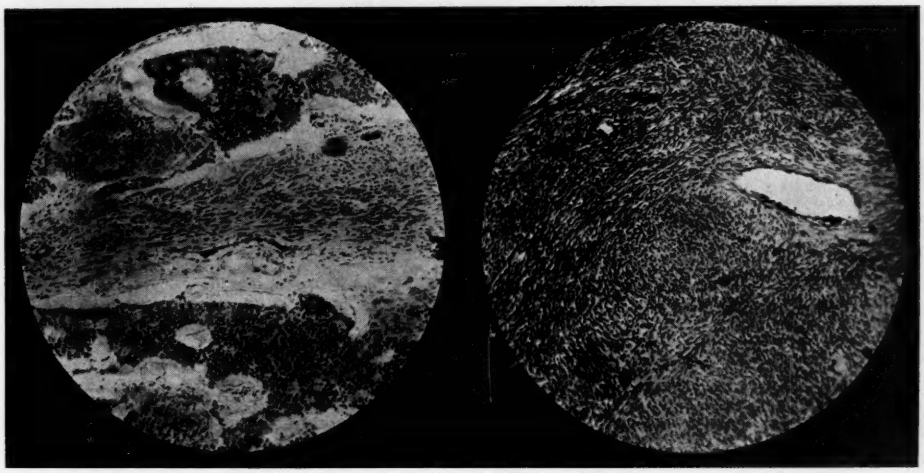

FIG. 31.—*Teratoma :* Epiblastic overgrowth. Basal-celled carcinoma. (Left) Typical rodent ulcer. (Right) Fibrosarcoma.

OTHER TYPES OF MALIGNANT EPIBLASTIC OVERGROWTH.

It is generally accepted that teratoma testis differs from the corresponding tumour of the ovary in the relatively poor representation of the epiblast, and consequently it is difficult to bring forward examples of malignant epiblastic overgrowth, though it is possible that some of the glandular carcinomata occurring in this series which have been classed as hypoblastic in origin are really derived from epiblastic epithelial elements.

Malignant epiblastic tumours of the testis may be assumed to occur in the following forms: (1) *Squamous epithelioma*; (2) *Basal-celled carcinoma*, already described; (3) *Neuro-epithelial tumours*; (4) *Chorion-epithelioma.*

Types (1), (3), and (4) do not occur in the present series, but a consideration of the literature supplies examples, and to make this survey more complete a brief consideration of these types appears warranted.

Squamous Epithelioma.—No example of this tumour in anything like a pure condition has appeared in the present specimens, which makes the discovery of the basal-celled carcinoma all the more remarkable. At the same time it is not uncommon to find areas in teratoid tumours where the epiblastic structures show a local preponderance, and in one specimen squamous epithelioma of unknown origin was suspected by a previous investigator.

In two old specimens epiblastic elements figured largely, but this was probably due to the greater resistance to disintegration provided by the horny tissues (*Fig.* 32).

The writer finds it difficult to appraise the value from the point of view of malignancy of the commonly observed epidermoid cysts lined by squamous epithelium and the equally common cell-nest or epithelial pearl formation. Though cell-nest formation is a highly typical feature of ordinary squamous epithelioma, it would appear that the epidermoid cysts so commonly present in teratoid tumours provide a condition *par excellence* for the development of cell-nests quite apart from malignancy.

Neuro-epithelial Growths.—No example of genuine overgrowth of neuro-epithelium has been observed, but at the same time no particular search has been made for it. Small groups of ganglion cells and scanty neuro-epithelial tissue have occurred in two specimens. Ewing states, however, that neuro-epithelial cell groups occur frequently and may show malignant degeneration.

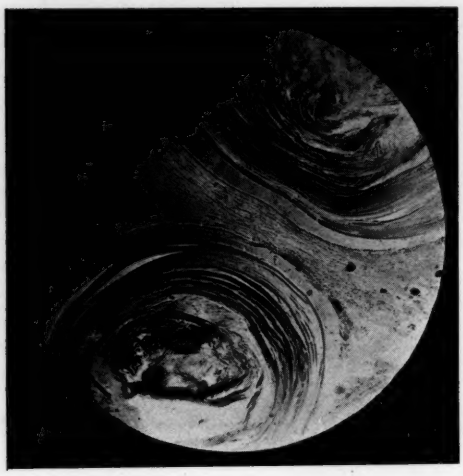

FIG. 32.—*Teratoma:* Epiblastic overgrowth, showing concentric horny nests which form the greater part of this section.

Chorion-epithelioma.—This highly interesting variation of teratoma testis, which reproduces in some cases, but not in all, the characteristic feature of chorion-epithelioma as observed in the female generative organs, is now a well-recognized form of testicular new growth, and is presumed to arise, if not from fœtal chorionic trophoblastic structures, at least from epiblastic cells homologous with those of the chorion.

In genuine cases chorion-epithelioma is characterized macroscopically, as in the uterus, by the predominance of blood-clot, which may appear to compose the bulk of the neoplasm or may appear as a localized hæmorrhagic nodule; and microscopically, by the multinucleated syncytial masses and the clear Langhans' cells. It also exhibits the same predilection to spread by the blood-stream and to form metastases in the lungs and liver. Nicholson[8] gives details of four chorion-epitheliomata met with in his collection of some sixty neoplasms of the testis, all occurring as a special development in teratoid tumours, and it is noteworthy that none appears in the present relatively large series, though it is highly possible that a more complete examination might have revealed examples. In one adenocarcinoma, multinucleated plasmoidal masses were observed in several small foci scattered amongst the carcinomatous tissue, but were not typical of chorion-epithelioma.

This tumour has passed through several phases of interpretation, and it would appear that pseudo-chorion-epitheliomatous structures occur occasionally and complicate the question. Several cases of this type have been recorded. MacCallum,[9] for instance, figures a typical example associated with a

teratomatous tumour of the testis which invaded the inferior vena cava through the spermatic and renal veins. Hydatidiform, grape-like structures hung free in the circulating blood, and more or less filled the great venous channels, but in spite of the resemblance to hydatidiform mole the villus-like bodies were not covered by chorionic epithelium.

Certain French observers consider the syncytial masses as epithelial giant-celled formations developing around vascular spaces, and regard the condition as angiosarcomatous. These pseudo-types, however, do not invalidate the fact that genuine chorion-epitheliomatous tumours occur in the testicle, as Schlagenhaufer[10] maintained, and reproduce all the characteristics of the uterine tumour—both local and metastatic—even occasionally manifesting the features of pseudo-gestation in the male breast.

METASTASIS IN TERATOMA TESTIS.

Metastasis may take place by lymphatic spread, blood spread, or both, depending on the predominance or admixture of carcinomatous or sarcomatous elements. In addition it is possible that transplantation of tumour fragments may take place in comparatively innocent tumours, such as the chondromatous teratoma, by direct invasion of venous channels. Paget's enchondroma is often regarded as an example of this, and the secondary tumours in the lung as produced by transplantation after erosion of the spermatic vein.

1. **Lymphatic Spread.**—In the majority of cases carcinomatous tendencies prevail and metastases involve the lymph nodes, especially the lumbar group primarily, and the intrathoracic nodes, brain, kidney, etc., secondarily. Bland-Sutton[11] has described a cystic teratoma which was followed later by a similar tumour in the left supraclavicular glands—an evidence of spread by the thoracic duct. In several of the present series the corresponding inguinal glands were involved, but this has always been associated with fungation of the tumour through the scrotum, or with firm adhesion of the tumour and its membranes to the scrotum.

2. **Blood Spread.**—In some cases sarcomatous features prevail and produce metastases, especially in the lungs and liver. Cases are recorded in which a multiple-layered teratoma has been associated with pulmonary or hepatic metastases exhibiting purely a round-celled sarcomatous structure, and the same feature has been observed in the malignant teratomata of the ovary. Chorion-epithelioma in particular, like the corresponding tumour in the uterus, spreads by the blood-stream and produces pulmonary and hepatic metastases.

As Ewing[12] points out, the structure of the metastases raises several interesting points bearing on the growth potentialities of the cell components of the teratomata. Representatives of all three blastodermic layers may be included in the same metastasis, in which case it seems conclusive that the metastasis must have arisen from a cell or cells capable of producing all three layers, while in other cases individual metastases from the same tumour may reproduce individual layers of the teratoma, suggesting that each metastatic embolus has been endowed only with the limited capacity of reproducing its own kind, either in embryonic or adult form.

AGE INCIDENCE.

Teratoma testis may be present at birth, as in the so-called dermoid, and thereafter may come to light at almost any age. Apart from the teratomatous cyst, there is in the present group a carcinoma of teratomatous origin from a boy, age 5. Most cases have appeared in the twenties, both of the comparatively innocent teratoma and malignant variations of it, and another group seems to be related to the forties in particular. It is impossible, however, to give any detailed information as to the age incidence, owing to lack of the requisite data in the majority of the older specimens. Only certain general impressions may be culled from the data available, and these suggest that a teratoma, innocent or malignant, may be associated with the full blast of adolescence (like the odontomata), or may lie latent till middle life (like the branchiogenetic cancer or cancer generally), when a predominantly carcinomatous tendency manifests itself.

THE ORIGIN OF TERATOMA TESTIS.

This may still be considered speculative. For the purposes of this paper only a brief survey of certain theories is indicated, and the reader is referred to the well-known text-books of pathology for detailed information and discussion.

Teratoma testis may be assumed to arise :—

1. **From Spontaneous Development** of the ordinary sex or germinal cells of the testis by a process analogous to parthenogenesis. This conception is specially connected with the name of Wilms, and is backed to some extent by experimental evidence, for in the case of frog's ova it has been shown that an artificial stimulus may initiate segmentation and produce imperfect embryos. If we endeavour to postulate the artificial stimulus in man, injury would appear to be the most likely factor, for the testes—especially in youth—are liable to traumata, and the imperfectly descended testis which is credited with a special tendency to become malignant is not exempt from repeated strain or slight injury.

2. **From an Isolated Blastomere: (*a*) Primordial; (*b*) Germinal.**—

a. It has been shown experimentally that in the early stages of segmentation of the fertilized ovum, if one of the blastomeres is isolated and placed in a suitable medium, it may develop into a more or less well-formed embryo, for the primordial blastomere, like the fertilized ovum, is totipotent and capable of giving rise to cells of any order, and therefore to teratoid tumours.

b. The germinal blastomere or primitive germinal cell, the progenitor of the ova and spermatozoa, arises later in the segmentation of the ovum, and is also totipotent. We do not know the precise origin of the primitive germinal or sex cells. They are believed by some to develop from the specialized epithelium (mesothelium) covering the genital ridge, and by others to be special cells budded off the morula which migrate into the genital area. This latter view affords a satisfactory and common origin both for the genital teratomata and the rare extra-genital tumours situated in the thorax or abdomen,

for it is easy to suppose that a primitive sex cell (germinal blastomere) may miss its correct destination in the future sex gland and become isolated in the thorax or elsewhere, and develop into a teratoma. Even if it reaches its proper destination in the future ovary or testis, it may still fail in the case of the testis to assume an orderly arrangement within the seminiferous tubules. Then, instead of passing through the phases of the sexual cycle and ultimately producing spermatozoa, such a misplaced sex cell may segment and, in virtue of its multipotent characters, produce a teratoid tumour. If development proceeds *pari passu* with that of the host, an adult teratoma results, for the tissues of the tumour are coeval with those of the host (e.g., the teratomatous or dermoid cyst); while if the aberrant blastomere lies latent in the genital gland and only begins to develop at a later period, say at puberty or still later under the stimulus of an injury, a less complex teratoid tumour is likely to result, owing to a reduction in the growth potentialities of the aberrant sex cell with repeated division.

From a consideration of the above theories certain points appear to stand out. Of the 'parthenogenetic' conception little is known unless it be interpreted in terms of trauma. Of the aberrant primordial blastomere we again know little, but it is asking too much of it to expect it to find its way into the sex glands with such regularity as indicated by the remarkable frequency of teratoma in the ovary and testis as compared with other situations. Consequently, it seems highly probable that the point of origin of the teratoma must be a cell which is commonly present in the sex glands. In the case of the testis we are left with the isolated, aberrant germinal blastomere or primitive sex cell which becomes misplaced in the tissues of the testis, and the primitive sex cell which, following its ordained course, becomes included within the seminiferous tubules and later passes through the phases of the sexual cycle. There does not appear to be any vital difference between the orderly cell and its descendants, and the misplaced cell, except in the degree of potentiality, and such differences may perhaps be related to the various degrees of complexity exhibited by teratomata.

As regards the possibility of misplacement of sex cells in the ordinary course of development of the testis, it is most likely, as Ewing stresses, to occur in or near the rete where the seminiferous tubules should normally fuse with the excreting tubules. Such a likely site of misplacement accords with the frequent origin of teratoma testis in the mediastinum.

CONCLUSIONS.

1. The majority of testicular tumours belong to the teratoid category.
2. The relative representation of the various blastodermic derivatives varies greatly in different specimens.
3. Overgrowth of one blastodermic element with partial or total (?) suppression of the others occurs frequently. Hypoblastic overgrowth is most common, mesoblastic next in frequency, and epiblastic least common.
4. Such overgrowth may be simple or malignant, and produces many variations from the typical three-layered teratoma.
5. Teratoma testis is potentially malignant to a high degree.

6. Many carcinomata of the testis can be directly related to the malignant conversion and overgrowth of the epithelial, more especially the hypoblastic, elements of teratomata.

7. The malignant change may be selective, but may affect both epithelial and connective-tissue elements in the same tumour.

8. The more adult the structure of the teratoma, the less liable is it to malignant change, and conversely.

Further Considerations.

1. The fact that the bulk of the testis proper is usually situated towards the upper pole in teratoid tumours suggests that, in early cases at any rate, some diagnostic use might be made of it. Testicular sensation limited to the upper pole might occasionally give a clue to the nature of a particular tumour.

2. In cases coming under observation early, it would appear possible, from a study of the cut surface of the smaller tumours, to enucleate the teratoma from its capsule, leaving the testis and epididymis intact. However, in a paired organ like the testis such conservatism would rarely be indicated.

3. The use of the X rays may occasionally give additional information in a dubious scrotal tumour if the cartilaginous elements are well developed, and especially if bone is a prominent feature, as in the teratomatous (dermoid) cyst.

The photographic work has been done by Mr. Frank Pettigrew, Technical Assistant to the Department of Surgery, to whom I am greatly indebted for his skill and care.

(To be followed by an article on the Spermatocytoma Group.)

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THE AFTER-RESULTS OF OPERATIONS FOR MALIGNANT DISEASE OF THE BREAST.

By ALAN C. PERRY, London.

The object of this investigation was to attempt to follow a relatively small series of cases through their subsequent histories in the hope that it might be possible to determine some or any of the factors which have a bearing on the prognosis after operation. It might appear presumptuous to draw conclusions after the recent monumental publication by the Ministry of Health[1] on this subject. The material, however, was collected some time ago, and it was felt that some details might be more evident on a close study of a small number of cases, although broad general conclusions could not be drawn. It is generally accepted, perhaps often without sufficient evidence, that prolongation of life results from the extensive modern operation performed for carcinoma of the breast. The excuse for this paper is that it gives a detailed analysis of the after-results in 653 cases, and attempts to correlate these results with possible factors affecting the prognosis in such cases.

Prognosis without Operation.—Before one can determine the value of any particular operation it is necessary to know exactly what would happen to the patient in the absence of any treatment. Therein lies the difficulty, as the ability to state with certainty how long any case of carcinoma of the breast will survive without operation is beyond the bounds of possibility. Furthermore, to ascertain even the stage reached by the disease on presentation for treatment is no easy task.

First, it is impossible to state how long the carcinoma has been present, for the patient's statement is notoriously inaccurate, as witness the number of cases who discover a fairly large lump by accident. Schwarzkopf[2] and Primrose[3] state that fourteen months is the average time that elapses between the known onset of the growth and the performance of any operation. The latter states that only 8 per cent of cases seek treatment within a month of the discovery of the lump, and that 50 per cent are untreated for a whole year. Deaver[4] gives the average history before operation as thirty months. This interval, so variously stated by these authorities, represents roughly the history of an operable case before coming for advice.

Secondly, the type of growth, in a clinical sense, has a great influence on the lethal rapidity. An 'acute' breast carcinoma will kill a patient within six months, whereas a slowly-growing one in an elderly patient may remain with her for ten or fifteen years and does not appear appreciably to shorten life. In such extreme cases the value of any operative interference would be especially difficult to determine, yet all such must be included in the statistics. The presence of undetectable visceral deposits in any particular case will shorten life considerably, and when one remembers that they may be present with even a small and comparatively slow growth, the difficulty of deciding on the

effect of the operation is intensified. Sampson Handley[5] states that if visceral deposits are present, life is unlikely to exceed twelve months.

When we come to consider these facts the immense difficulties facing any one who desires accurate knowledge are realized. The past and future of any particular case being lost in obscurity, one can only suggest the effect of operation on the latter with considerable trepidation.

Standard of Cure.—The only true cure in this disease is a hypothetical one—viz., a patient has survived her normal expectation of life after operation, and a most minute post-mortem examination shows no signs of carcinoma in any organ of the body, and death occurs from some entirely different cause. Such a proof of cure is impracticable, as even the most careful examination might fail to reveal a minute deposit of carcinoma in an inaccessible organ, such as the medulla of a bone.

Recurrence many years after operation does take place, and is becoming more recognized as an essential feature of the disease. In this series is found a case with a first recurrence in the spine after fifteen years. Such a case immediately negatives any attempt to fix a time limit for the standard of cure. Volkmann's three-year limit as a criterion was soon found to be too brief. Other writers, when giving statistics, attempt to give their results after a fixed period, although in view of these late recurrences this must necessarily be fallacious. Bloodgood,[6] giving the statistics of the Johns Hopkins Hospital, states the condition of the patients after five years. Peck and White,[7] whose figures are regarded as amongst the most satisfactory, state that 39 per cent of their cases were alive after five years. The usual method in these series is to state the number of patients alive and well, or with recurrences, after such a fixed period.

In this paper it has been deemed advisable to adopt the method of determining how long each patient has lived. This was done because it is felt that a patient who develops a recurrence after eight years, although she may not be 'alive and well', certainly does give some indication of the efficacy of the operation.

Operative Mortality.—Of 653 cases, 11 died in hospital, thus giving a mortality of 1·7 per cent; of these, one died from infection, one under the anæsthetic, one from heart failure, and the remainder from pulmonary complications and pulmonary embolism.

FACTORS WHICH MIGHT INFLUENCE PROGNOSIS.

Certain factors are generally accepted as having some bearing on the after-results of carcinoma of the breast.

The Length of History.—This has been touched on previously, and in view of its inaccuracy must be disregarded as throwing any light on the survival period after operation. A lump may have been discovered some years before or only a few hours, and in each case we are completely ignorant as to the duration of the carcinoma. The figures in this series are so misleading that it was felt no great advantage would accrue by recording them.

The Age of the Patient.—It is commonly stated that the younger the patient the worse the prognosis, and this bearing of age on the disease will be

analysed later. It must be borne in mind, however, that there is always a certain degree of hesitancy in diagnosing carcinoma in a patient under 40; and therefore treatment may not be furnished as expeditiously as it might in older patients. Again, younger patients are more liable to the general disturbances following pregnancy, and exacerbations of the growth which undoubtedly follow child-bearing. Furthermore, cases are rarer in the younger, and therefore figures based on small numbers are not of the same value. The average age of the cases (at the time of operation) in this series is 51·3 years, and they are distributed in the following manner:—

Age	No. of Cases	Age	No. of Cases
Over 80	1	45 to 49	122
75 to 79	8	40 „ 44	105
70 „ 74	25	35 „ 39	40
65 „ 69	45	30 „ 34	26
60 „ 64	74	25 „ 29	7
55 „ 59	73	Under 25	2
50 „ 54	118		

There is thus a total of 646 in which the age is stated. It will be seen that the maximum incidence of the disease occurs between the ages of 40 and 54, and this is in accordance with most of the other organs affected with carcinoma.

The Pathological Type of Growth.—Many classifications have been devised for the various kinds of malignant disease occurring in the breast, and it is generally conceded that they vary in respect of their malignancy. Certain varieties, however, occur infrequently, and it is therefore advisable to be cautious in drawing conclusions, because in a small number of cases it may be that the other factors are the more important. In only two varieties of the classification adopted could no deaths be traced, viz., the papillary cystic and the intracystic carcinomata. It is well, however, to bear in mind that none of the cases in these groups has been traced over a lengthy period, the longest being six years.

Carcinomatous hyperplasia, although often classified as a pre-cancerous rather than as a malignant condition, is included, because two cases died of secondaries, one three and the other seven years after the operation, and in neither were the glands at first involved. One was 42 and the other 50. The effect of the pathological type of growth on the after-results is fully discussed in a later section.

The Presence of Affected Glands.—Deaver and McFarland,[8] in their exhaustive book, *The Breast*, state that the absence of involvement of the glands gives a 4 to 1 better chance in the post-operative prognosis. Microscopic examination of the glands removed in this series was carried out in a vast majority of cases. It was found that only 28 cases showing microscopic deposits survived for seven years or over, whereas 84 cases showing no deposits in the glands survived for the same period. This gives a 3 to 1 chance in favour of the cases where microscopy shows the glands free.

It is interesting to note that two cases showed tuberculosis of the axillary glands removed at operation. One, age 51, died after two years, and the pathological report on her growth was carcinoma simplex. The other, age

61, showed no recurrence after ten years, and microscopy showed a scirrhous carcinoma.

The presence of clinically enlarged glands is of little value in prognostication, as there were 36 cases of non-specific chronic inflammation in the axillary glands on microscopic examination. Of these, 6 were untraced and 16 survived for more than seven years. It would, therefore, appear that if chronic inflammation is demonstrated in the axillary glands, the prognosis is likely to be improved in the proportion of 33 to 7.

The Effects of Preliminary Excision.—In this series there were 30 cases which underwent preliminary excision, as out-patients, by the general practitioner, or for diagnostic purposes. Of these, only 6 survived the seven-year period, and it is interesting to give their particulars.

Table I.—Cases of Excision some time before Operation.

Age	Pathology	Period elapsing before Complete Operation	Result
60	Intraductular carcinoma	1 month	13 years, alive and well
33	Carcinoma simplex ..	3 weeks	9 years, died
61	Intraductular carcinoma	2 years	8 years, died
58	Scirrhous carcinoma ..	2 weeks	7 years, died
60	Papillary cystic carcinoma	4 days	9 years, died (other causes post mortem)
29	Carcinomatous hyperplasia	3 weeks	6 years, alive and well

It will thus be observed that of these cases 4 belong to pathological groups which are considered to be of the less malignant variety, and 3 of these are included in what ought to be termed 'cures'.

Of the 14 cases in which preliminary excision was performed immediately preceding the operation, 4 could not be traced, and 4 had not been done long enough to show seven years' freedom, although they are still without a recurrence. Of the remainder, 4 exceeded the seven years, of which one died after ten years from other causes. The results in the remaining 3 were as follows:—

Table II.—Cases of Excision Immediately before Operation.

Age	Pathology	Survived	Result
42	Scirrhous	4 years	Died: recurrence other breast
34	Scirrhous	1 year	Died: recurrence in spine
42	Carcinomatous hyperplasia	3 years	Died: carcinoma of lung

Few sound conclusions can be drawn from this small number of cases; but it would appear that preliminary excision immediately followed by the complete operation has little effect on the question of prognosis, as either of the first two cases would have a grave prognosis. Regarding the third, there was a recurrence within thirty months in the supraclavicular glands,

and this would appear to suggest considerable malignancy in spite of the microscopic diagnosis.

Such evidence as we have would seem to indicate that preliminary excision at a period remotely antecedent to the complete operation, for diagnostic or other purposes, is a dangerous proceeding, whereas excision as a prelude to the operation has little or no influence on the after-result. This is, of course, in accordance with the accepted teaching.

Selection of Cases.—The results of any particular series will depend largely on the selection or otherwise of cases for operation. In this series, however, several surgeons have performed the operations, and each would have a different standard of operability. Furthermore, when we consider that cases who die from internal secondaries have a much more peaceful death than those who die with a fungating growth, it is unlikely that cases on the verge of being inoperable have been refused what at best might be only a palliative measure. It is certain, therefore, that many advanced cases are included. This is borne out by the fact that no fewer than 20 showed ulceration of the skin, and is further demonstrated when we find that 61 per cent of cases were adherent to the overlying skin.

Regarding private patients and hospital patients, there is said to be a more favourable prognosis for the former than the latter. The difficulty of following up hospital patients, particularly if they are well, must, however, be borne in mind. In the practice of one surgeon the private patients show 50 per cent of possible cases surviving the seven-years' period, whereas hospital patients show only 21 per cent.

The Effect of X rays.—An attempt was made to ascertain the effects of X rays applied to cases as an adjunct to operative interference. It was found extremely difficult to get comparable figures, because it is only in recent years that the extensive application of X rays has been practised after operation ; and, furthermore, if X rays are applied after operation, there is no means of knowing that the operation was not entirely responsible for the absence of secondaries. Undoubtedly X-ray treatment of the secondaries developing in the scar was efficacious in numerous instances, with the almost certain prolongation of life. Therefore it must certainly be continued as a prophylactic as well as a means of treatment for recurrences.

The Situation of the Growth in the Breast.—The superficial lymphatics from the lower inner quadrant of the breast drain downwards to the epigastrium and so reach the abdominal lymph glands. This is the so-called dangerous area of the breast, because once a carcinoma in that region has invaded the skin, lymphatic spread to the abdomen is easy, and secondaries within the peritoneal cavity are probable and, of course, beyond treatment. Before one can determine this point, one must observe the relative frequency with which different parts of the breast are involved. In this series, where the situation of the growths is stated, we find the following percentages :—

Upper and outer quadrant	..	50 per cent
Upper and inner ,,	..	17 ,,
Lower and outer ,,	..	15 ,,
Lower and inner ,,	..	6 ,,
Central	..	12 ,,

On analysing the cases that have survived for over seven years we find the situation represented in the following percentages:—

Upper and outer	quadrant	..	46	per cent
Upper and inner	„	..	17	„
Lower and outer	„	..	12	„
Lower and inner	„	..	9	„
Central	..	..	16	„

There is thus very little difference between the two sets of figures, any slight advantage as to the prognosis being for the lower and inner quadrant or so-called dangerous area. It would be wrong to be dogmatic on this small series of cases; but it seems that the situation of the growth has very little bearing on the question of prognosis, and certainly the carcinoma in the lower and inner quadrant does not increase the danger to the patient.

RESULTS OF CASES.

The cases examined for the purposes of this paper were operated on by certain surgeons up to within two years of the time that the investigation took place. Of the total number, 80 were completely untraced, and 182 were traced for a period and then lost sight of. The method adopted was to learn the length of time that the patient had survived the operation with or without recurrences. This was done for certain reasons instead of selecting all the cases operated on up to, say, five years ago, and ascertaining how many were alive and well. Firstly, a surgeon may have followed up a case for seven years, and it may be impossible to say what has happened after that time. Secondly, late recurrences do occur, and the fact of a patient being alive and well after five years is in no sense a cure, any more than the patient who develops a recurrence after ten years. Thirdly, it was thought that the early recurrences might throw some light on the type of case that gave rise to them, and also on the effect of treatment on such recurrences. Lastly, it might show when recurrences did occur, where they occurred, and perhaps why.

Table III.—Results including all Untraced Cases.

Years Lived after Operation	Number of Cases	Possible Number of Cases	Percentage
Over 16 ..	6	67	9
15 ..	9	69	13
14 ..	14	87	16
13 ..	22	141	16
12 ..	29	165	17
11 ..	39	195	20
10 ..	50	244	20
9 ..	65	297	22
8 ..	86	365	23
7 ..	112	395	28
6 ..	128	462	28
5 ..	153	553	28
4 ..	196	600	33
3 ..	236	638	37
2 ..	349	653	53

Table III includes all untraced cases, whereas the next table shows the partially traced and totally untraced cases separated out. The percentage and figures in *Table IV* are completely different from those in *Table III*, as the 'alive cases' are those alive in 1923, whereas *Table III* only takes cognizance of the number of years lived. For example, a woman may have lived for seven years and died five years ago; therefore she appears in *Table IV* as died, but in *Table III* she appears as having lived seven years.

Table IV.—Results excluding Partially and Totally Untraced Cases.

Up to	Total Operations	Now Dead		Now Alive		Partially Traced	Untraced
		Number	Per cent	Number	Per cent		
1907	67	18	27	6	9	27	16
1908	69	18	26	8	11	27	16
1909	87	25	29	10	11	36	16
1910	141	41	29	18	13	58	24
1911	165	55	33	23	14	60	27
1912	195	67	34	30	15	67	31
1913	244	89	36	45	18	77	33
1914	297	105	35	58	19	89	45
1915	365	130	36	77	21	103	55
1916	395	142	33	85	22	110	58
1917	462	164	35	106	23	128	68
1918	553	175	30	137	25	170	71
1919	600	187	31	174	29	171	72
1920	638	190	29	189	29	180	79
1921	653	198	29	193	29	182	80

In *Table III* it is interesting to note the sudden drop in the percentage of those surviving after seven years. The only deduction one can draw from this is that an eight-year survival period would be a useful one to adopt if it were desirable to establish any period as indicative of good results from the operation.

The Effect of Age on Prognosis.—*Table V* demonstrates that the most favourable age for operation is the quinquennium 50 to 54, 40 per cent of

Table V.—The Effect of Age on Prognosis.

Age	Per Cent Living more than 7 Years	Average Number of Years	Per Cent Living more than 3 Years	Average Number of Years
Over 70 ..	—	9·0	44	3·9
65 to 69 ..	12	8·5	40	5·4
60 „ 64 ..	22	8·3	44	6·2
55 „ 59 ..	11	7·8	28	5·7
50 „ 54 ..	20	10·0	40	7·1
45 „ 49 ..	15	9·1	32	6·6
40 „ 44 ..	13	9·7	37	6·0
35 „ 39 ..	7	9·0	24	5·9
30 „ 34 ..	16	8·3	31	6·1
Less than 30 ..	—	—	5 cases	5·6

such cases surviving more than three years, with an average of 7·1 years, and no less than 20 per cent of such cases surviving more than seven years, with an average of 10 years. It is interesting also to note that the results for ages 60 to 64 are better than those for ages 55 to 59. Can it be possible that immediately after the menopause a period ensues of lessening resistance to carcinoma, after which it rises again? These figures also bear out the statement that carcinoma has a much worse prognosis in the young, with the exception of the age period 30 to 34; but as the cases are rarer at this age, the figures are more unreliable than where larger numbers are concerned.

The Influence of the Pathological Variety of Growth.—

1. *Scirrhous Carcinoma.*—This group formed 58 per cent of the whole series. Of these :—

37·5	per cent	lived	more	than	3	years,	with	an average of	5·9 years
10·4	„	„	„	„	7	„	„	„	8·7 „
21	„	died	within	3	years				
14	„	were	untraced.						

2. *Carcinoma Simplex.*—This group formed 14·2 per cent of the whole series, and of these :—

32·4	per cent	lived	more	than	3	years,	with	an average of	7·8 years
16·2	„	„	„	„	7	„	„	„	11·2 „
19	„	died	within	3	years				
20	„	untraced.							

3. *Medullary Carcinoma.*—This group formed 8·8 per cent of the whole series, and of these :—

38	per cent	lived	more	than	3	years,	with	an average of	7 years
21	„	„	„	„	7	„	„	„	9 „
19	„	died	within	3	years				
19	„	untraced.							

4. *Mucous Carcinoma.*—Only 4 cases were thus described, and one of these died after two years, one was untraced, and the others survived over three years.

5. *Papillary Cystic Carcinoma.*—Six cases were described, and no death was recorded.

6. *Intracystic Carcinoma.*—Twelve cases were described, with no deaths, although two cases were untraced.

7. *Intraductular Carcinoma.*—Eight cases, of which 2 were untraced; of the others, 2 died at nine and eight years respectively, and the others survived seven years or over.

8. *Carcinomatous Hyperplasia.*—Fifteen cases are included in the series, of which the large number of 5 were untraced; 2 died at seven and three years respectively, and the remainder are alive with an average survival of five years.

9. *Sarcoma.*—Only 3 cases were included, and of these one could not be traced, one is alive after seven years, and the other died after two.

The first and most striking feature of these figures is the large percentage of cases of medullary carcinomata that survive more than seven years, this percentage representing twelve cases, one of whom is alive and well thirteen

years after the operation. It would be rash to state that on these figures medullary carcinoma is less malignant than scirrhous carcinoma, but they certainly demonstrate the fact that medullary carcinoma has by no means a hopeless prognosis as is so often thought, but that the survival period may be considerable. Furthermore, this list demonstrates that carcinomatous hyperplasia in the breast is a definitely malignant condition and should be treated as such.

RECURRENCE AFTER OPERATION.

There is definite evidence of recurrence after operation in 35 per cent of the cases examined. The situation of the first observed recurrence expressed as percentages was :—

Local (i.e., the operation area)	52 per cent
Supraclavicular glands ..	15 „
Intrathoracic	14 „
Intra-abdominal	10 „
Spinal	8 „

When we examine the time at which these recurrences first appeared after operation we observe :—

In the First Six Months.—During this period 14 per cent of the recurrences occurred, and the average age of the patients affected was 45·5 years.

In the First Year.—Before the twelve months had expired, 40 per cent of recurrences occurred, with an age incidence averaging 46 years.

Within the First Eighteen Months.—Here 55 per cent had occurred, with an average of 46·6 years.

Within the First Two Years.—70 per cent of recurrences had occurred, with an average age of 47·2 years.

After Two Years 30 per cent of the total number of recurrences first appeared, and these cases had an average age of 51 years.

No fewer than 9 cases developed recurrences after seven years, the longest period being that of the one previously mentioned at 15 years—spinal in situation.

Several cases which developed recurrences and were treated survived for considerable periods. One four years after the operation developed a secondary nodule which was excised, and she was in good health five years later. Another had a local recurrence three months after, was treated with X rays, and was alive and well five years later. A third developed a secondary after two years, and this was excised, but she died of general recurrences three years later. A fourth and very interesting case, age 33, developed after eighteen months a secondary which was removed, and she died six years later from abdominal recurrences.

From the investigation of cases developing recurrences after operation one arrives at certain deductions :—

1. Recurrence is a frequent post-operative event, occurring in 35 per cent of all cases, or rather more if untraced cases are excluded.

2. More than half of these recurrences are at first situated in the operation area. This would suggest that operators do not remove all the affected

tissues, which should be an argument for making the operation, even in early cases, as thorough as possible.

3. First recurrences in the supraclavicular glands occurred in 15 per cent. We might reasonably infer that excision of these glands should be practised in all cases, even though they form a remaining barrier between the growth and the thorax. No case of supraclavicular gland enlargement treated either by excision or X rays could be traced as having survived more than eighteen months, and intrathoracic deposits were frequently present before death.

4. Early recurrences are more common in younger patients, and late recurrences in the older. This would seem to confirm the conclusion previously reached, that carcinoma is a more malignant disease in patients before the menopause.

5. The treatment of local recurrences does not appear to be hopeless. Immediately they are detected they should be widely excised and further prophylactic doses of X rays administered. In such cases one might tentatively suggest that a local recurrence should be treated as the original disease was, and that the supraclavicular glands be excised, if this has not been already done.

6. X-ray treatment undoubtedly has a beneficial effect on local recurrences. It is therefore feasible to suppose that its effect on the carcinoma cells left after an operation should be equally salutary. In such cases the operation must be as thorough as if no X rays were to be used.

7. Apart from those in the spine, first recurrences after operation in the bones seem very rare, and only two such cases were noted : one in the humerus and the other in the femur.

CONCLUSIONS.

One is diffident about drawing conclusions from a small series of cases, especially in face of the great difficulty there is in tracing patients for any length of time unless they are persistently written to, as is the practice of so many surgeons to-day. However, one can state without undue dogmatism that certain facts appear to have been elicited.

1. When we find that 28 per cent of all cases survive more than seven years, the operation can be said to have justified itself.

2. The most favourable age for operation is the quinquennium 50 to 54, both as regards duration of life, and also as regards recurrence being delayed for a more lengthy period.

3. In younger patients the prognosis is not so good, and recurrences are more likely to occur early.

4. The absence of deposits of carcinoma in the axillary glands improves the prognosis, and it is possible that the microscopic evidence of chronic inflammation suggests an increased resistance to the disease.

5. Medullary carcinoma is not such a fatal type as it is so frequently considered.

6. Cases showing carcinomatous hyperplasia should be regarded as definitely malignant, and a radical operation performed.

7. Papillary cystic and intracystic carcinomata are the least malignant, and intraductular carcinoma is only slightly more so.

8. Late recurrences do occur even as long as fifteen years after operation. This possibility almost precludes the establishment of a cure in malignant disease of the breast. It suggests, moreover, that cases should be thoroughly examined at definite intervals, and any recurrence observed should be dealt with preferably as a new focus of malignant disease.

9. Although the length of history given by the patient is misleading, there can be no doubt that the earlier the case is operated on, the more favourable will be the prognosis. All operations must be thorough, and one would be inclined to extend the operation still further by removing the supraclavicular glands in many if not all cases.

10. There appear to be no grounds for believing that the lower inner quadrant of the breast is a dangerous area for carcinoma to originate.

11. A counsel of hope is necessary, in that life is certainly prolonged by the operation, and in many hopeless cases the final stages of the disease are made more bearable for the patient.

In conclusion, I should like to thank the surgeons of the London Hospital for permission to use their cases, and especially would I thank Sir Hugh Rigby, Mr. Sherren, Mr. Hugh Lett, and Mr. Walton for placing their records at my disposal, and also my own chief, Mr. Russell Howard, for much valuable instruction in this subject.

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URETHRAL POUCHES.

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INTRODUCTION.

The earliest reference to urethral pouches appears to be one mentioned in Sir Charles Mansfield Clarke's *Diseases of Females* which was published in the year 1814. The reference, which occurs on page 270, reads as follows: "Sometimes a pouch forms in the posterior part of the urethra, in which a few drops of urine lodge and from which situation it may be pressed out by the finger applied to the part".

Pouches of the male urethra have received scant attention in English medical literature. In 1885 Sir William Arbuthnot Lane[8] described a diverticulum in connection with the prostatic urethra a quarter of an inch in front of the sinus pocularis. Hurry Fenwick[5] recorded a case from the London Hospital in 1886 occurring in a man, age 57. This patient was admitted with urinary extravasation, an incision was made, and eight stones were removed from a pouch situated in the perineum and immediately behind a stricture. He recovered, but later on he returned to the out-patient department, a fresh pouch having appeared. It was situated 2½ in. from the meatus, and Fenwick suggests that it was due to an anterior stricture, which had been masked by the inflammatory swelling consequent upon the extravasation.

The following article is based largely on the clinical cases and pathological records of the London Hospital. It treats of the condition in the male; pouches in the female are only considered in so far as their etiology bears upon the causation in men.

Anatomy.—The male urethra is divided anatomically into the prostatic, membranous, and spongy portions.

The first portion, enclosed within the prostate gland, is 1¼ in. long. Its most marked anatomical feature is the verumontanum or urethral crest, a vertical raised fold composed of mucous membrane and prostatic tissue. The crest is situated on the posterior wall and rises to its maximum elevation in the middle of the prostatic urethra. At its summit is situated the fine slit-like orifice of the uterus masculinus, a small cavity usually about 6 mm. long. On either side of this opening are those of the common ejaculatory ducts, whilst still farther laterally the prostatic ducts open into a depression known as the prostatic sinus.

The membranous urethra, ¾ in. in length, extends between the two layers of the triangular ligament and is surrounded by the compressor urethræ muscle. Situated posteriorly to the membranous urethra on either side of the mid-line lie the two glands of Cowper; their ducts, however, open into the bulb of the urethra and not into the membranous portion. After

piercing the anterior layer of the triangular ligament the urethra enters, and is surrounded by, the corpus spongiosum.

The spongy portion of the urethra is of variable length and opens on the glans penis.

The Urethral Lacunæ and Glands are of two varieties: (1) The lacunæ of Morgagni; and (2) The glands of Littré.

1. The lacunæ of Morgagni are found in the cavernous urethra on the dorsal wall and near the mid-line; they are non-secretory, and are lined by the epithelium of the urethra. The lacuna magna is by far the largest of this series, and is situated on the roof of the dilatation of the urethra, just within the meatus, known as the fossa navicularis.

2. The glands of Littré may be divided into those confined to the mucous membrane and a larger type which extends into the submucous layer. They are found in the anterior two-thirds of the cavernous urethra, in dorsal, ventral, and lateral rows.

Development of the Male Urethra.—Embryologically the urethra is divided into two portions, the one extending from the bladder to the uterus masculinus, whilst the other comprises the whole of the remaining urethra.

The Proximal Portion.—In the early embryonic stages the urinary, genital, and intestinal tracts have a common opening, the cloaca. The partition between the intestine and the allantois grows caudally, so dividing the cloaca into ventral and dorsal segments, the latter subsequently becoming the rectum. The ventral cloaca in time becomes divided, the upper part forming the bladder and the lower the urogenital sinus. The connection between these two segments is a short canal which forms the upper part of the urethra. The urogenital sinus affords a common opening for the two fused Müllerian ducts and this portion of the urethra.

The Distal Portion.—At about the fifth week of intra-uterine life the genital eminence appears at the anterior extremity of the urogenital sinus. This genital tubercle elongates to form the penis and a groove appears on its ventral surface; the folds bounding this groove are named the genital folds. The genital folds meet and fuse, thus converting the urogenital sinus and the groove into a canal which is the distal portion of the urethra. The small portion of the urethra within the glans is formed separately from a depression on its under aspect, packed with a plug of ectodermal cells, which later breaks down and so the urethra is completed.

An interesting observation is that made by Johnson[6] on an embryo of 88 mm. In addition to the developing urethral glands "are seen a number of cystic epithelial ducts, some of which are in no way connected with the epithelium of the urethra". They are situated in the connective tissue of the median raphé and have the same epithelial lining as the urethra. Along the mid-line of the rectal wall of the urethra is a definite cord-like thickening of the epithelium, and the appearance suggests that it is being cut off from the urethra. The ducts, mentioned above, have probably been cut off in like manner at an earlier stage.

The uterus masculinus is the fused lower portions of the two Müllerian ducts.

Types of Pouches.—The most usual classification is that introduced by Watts[10]:—

1. CONGENITAL.
2. ACQUIRED:—
   a. From dilatation of the urethra: (i) Calculus; (ii) Stricture.
   b. From perforation of the urethra: (i) Injuries; (ii) Rupture of abscesses; (iii) Rupture of cysts.

The size varies enormously—from the smallest dilatation of the normal glands to a pouch the size of a cocoa-nut, as in Mr. Russell Howard's case reported below. A pouch which gives rise to symptoms is usually about as large as a walnut. The lining mucosa is smooth, and continuous with that of

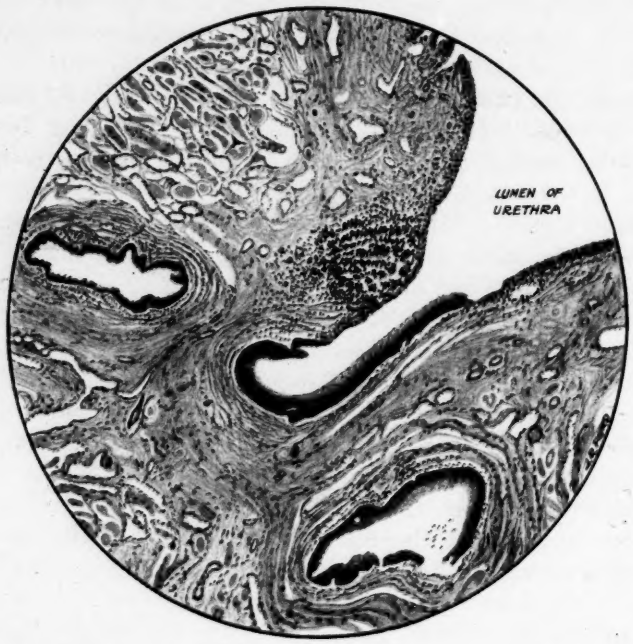

FIG. 33.—Section showing urethral wall with dilated crypts behind a stricture.

the urethra. The aperture of communication may be small or, on the contrary, the pouch may appear as a dilatation of the urethral floor. Infection and inflammation may occur in a pouch in which urine stagnates, and stone formation may ensue.

Frequency.—I. R. Sisk,[9] in reporting a recent case, stated that not more than eighty complete cases of urethral diverticula have been recorded. It would seem, however, that this exaggerates considerably the rarity of the condition, for a number of authors have recorded small series, e.g., Bumpus,[2] 4 cases; Escat,[4] 4 cases; and Englander,[3] 2 cases. At the London Hospital also 4 cases have come under observation clinically within the last eight years. In addition, 4 further cases have been found in the records of the London Hospital Pathological Institute during the past ten years.

Urethral pouches are undoubtedly often overlooked because: (1) The symptoms may be very few and unimportant; (2) The signs are often obscure even should a patient present himself for examination. Minute pouches of no clinical significance are frequently met in post-mortem examinations, and extend from the dilated urethra behind a stricture. The condition is illustrated by *Figs.* 33 and 34, which show the appearances both microscopically and macroscopically. Sir Charles Bell,[1] in describing the appearances behind a stricture, stated: "But the most frequent appearances are a number of cavities on each side of the verumontanum. These cavities are only enlargements of the natural ducts of the gland (i.e., prostate). They are sometimes so large as to admit the end of the largest bougie".

FIG. 34.—Specimen showing urethra and bladder. There is a stricture of the bulbous urethra, proximal to which are several dilated crypts, in one of which a bristle has been placed.

Congenital Pouches.—These are much rarer than the acquired variety. Of sixteen congenital cases analysed by Watts, all except two were found in relation to the penile portion of the spongy urethra. *Case* 3, described in this article, affords an example of a congenital pouch in which the communication with the urethra was noted 1½ in. in front of the triangular ligament.

Many theories have been advanced to explain the origin of congenital pouches. As the cavity is found on the ventral aspect of the urethra, two theories which could explain the condition are: (1) Imperfect fusion of the two genital folds; and (2) That one of the cystic epithelial ducts described by Johnson may retain its urethral communication and become dilated. Some, however, may arise from the Müllerian ducts, but they must be very rare. Escat[4] recorded a case which he regarded as of this type, in which a diverticulum "the size of a nut", situated at the posterior part of the scrotum, communicated by a long canal with the posterior urethra.

An extremely interesting specimen in the London Hospital Pathological Institute (*Fig.* 35) illustrates the possibility of this mode of origin. The specimen was obtained from a male, age 51, who had died from hæmorrhage after a gastrojejunostomy. There was slight hypertrophy of the bladder. The urethra shows a cystic dilatation of the uterus masculinus 1·5 by 1·2 cm. Microscopic sections have been taken, and Professor H. M. Turnbull reports as follows :—

> In microscopic sections the cavity contains a yellow coagulum, and is lined by a single row of low cubical or flat epithelial cells. The lining rests upon a definite wall, which is composed of circularly directed muscle-fibres and contrasts conspicuously with the prostatic stroma in its abundance of stout elastic fibres and its relative scarcity of collagenous fibres. Within this wall are a few acini, which are lined by similar epithelium and which are usually filled with a similar coagulum.

Fig. 35.—Specimen showing dilatation of the uterus masculinus.

Acquired Pouches.—

Relation to Urethral Obstruction with Dilatation of the Urethral Glands.—That the glands and lacunæ are frequently slightly dilated behind a stricture has already been mentioned and illustrated by diagrams. A rather more exaggerated example has been noted in the pathological records.

Necropsy 181/1914.—A tailor, age 16, died of cerebral hæmorrhage complicating cardiovascular hypertrophy and nephritis. The kidneys were hydronephrotic and showed focal areas of fibrosis with cyst formation. The bladder and ureters were dilated. There was a diverticulum of the penile urethra and a large scar surrounding and constricting the meatus. Clearly if this condition were progressive it would result in the formation of pouches not only of pathological but also of clinical interest. Nevertheless this is probably an unusual method of formation of large pouches, for although the glands are found on all walls of the urethra, diverticula are found on the ventral wall only.

Johnson[7] has recorded a case of a large scrotal cyst with a pedicle which could be traced to a point corresponding in position to the duct of the left Cowper gland, thus indicating the possibility of a pouch being developed from these glands.

Relation to Urethral Obstruction with Peri-urethral Abscess.—An entirely different mode of formation in association with stricture is illustrated by the following case :—

Case 1.—A traveller, age 34, admitted in 1924, under Mr. E. C. Lindsay, with acute retention of urine.

History.—The patient had suffered from gonorrhœa in 1912, and this was followed by dysuria two years later. In 1919, when at sea, he experienced an attack of acute retention of urine, which was relieved naturally by a hot bath. On the following evening retention again occurred, when a hot bath failed to give relief. As catheterization by the ship's doctor failed, the patient was taken to a general hospital ashore. Under a general anæsthetic a No. 4 metal catheter was passed and tied in for a very prolonged period. The formation of an abscess ensued, at a point about 2½ in. from the external meatus, and at the site of the present sac. This was accompanied by rigors and pyrexia. Pus was squeezed out, and later the catheter was removed. Dilatation was carried out with an expanding bougie, and the patient was discharged from hospital.

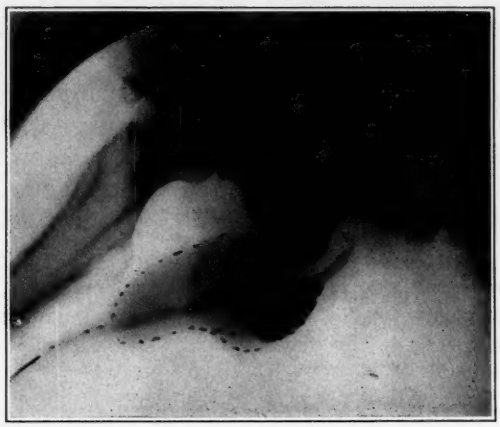

Fig. 36.—Radiogram showing acquired urethral pouch distended with sodium bromide. (*M. H. Jupe.*)

In 1921—and again at sea—retention recurred. Hot baths and catheterization by the ship's doctor failed, partial relief eventually being obtained by the passage, in small quantities and with much pain, of ten ounces of urine. At the British Hospital, Port Said, dilatation was carried out in two stages until a 13/15 Lister bougie could be passed. During the ensuing years the stream on micturition gradually lessened. A month before admission the dysuria was so marked that a small sound was passed. Spasm and retention ensued and were again relieved by instrumentation—this occurred on three occasions.

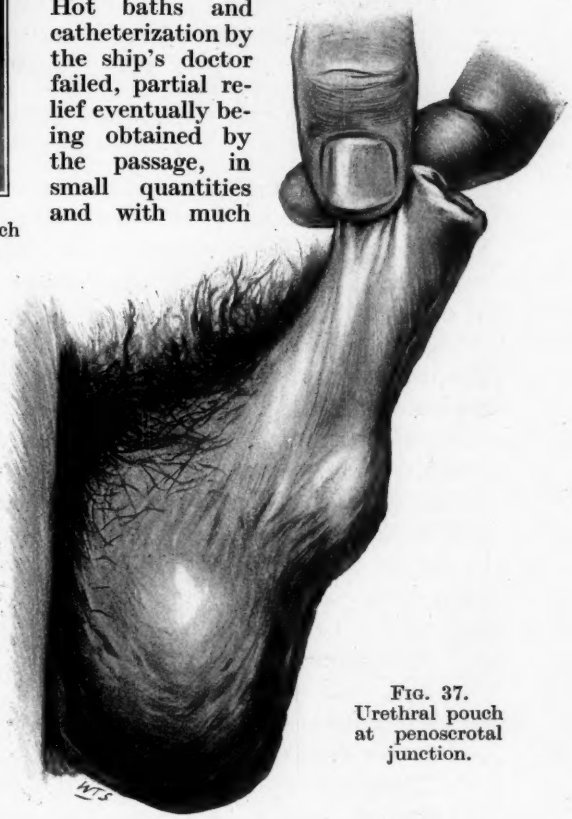

Fig. 37. Urethral pouch at penoscrotal junction.

He was admitted to the London Hospital suffering from urinary retention, and was relieved by suprapubic puncture of the bladder. Five days later an internal urethrotomy was performed and two strictures were discovered, one 2½ in. from the meatus and one in the bulb. A urethral pouch was discovered, situated at the penoscrotal junction, and was, when distended, the size of a walnut. He was transferred to, and is still attending, the Stricture Section of the Genito-urinary Department, where an X-ray picture of the pouch distended with sodium bromide was taken, and is shown in *Fig.* 36. The condition as seen at present is illustrated by *Fig.* 37. On urethroscopic examination the communication with the urethra is wide and the cavity projects down from the urethral floor. The wall is smooth and of a white colour.

Urethral Pouches in Women.—This condition in the female will be considered only in so far as it has a bearing on the causation of the same pathological condition in the male.

The female urethra corresponds to that part of the male urethra which extends from the bladder to the uterus masculinus, a very uncommon site for pouches. As urethral stricture is also very rare and does not appear to be associated, it seems certain that there must be some additional factor operating in the female to account for diverticula. The physiological process of child-bearing at once suggests itself as the possible factor, and this is supported by the clinical features of recorded cases. The usual history is that the swelling followed a confinement.

During delivery the urethra becomes very much elongated and is subjected to pressure. As the urethra has an anterior concavity, the convex vaginal wall will be more liable to damage than the pubic wall. A urethro-vaginal fistula may be thus produced. If, however, the injury is of a lesser degree, the damage to the urethral wall may result in the formation of a hernial protrusion—in other words, a pouch.

Case 2.—A multipara was admitted to the V.D. (Female) Department, in February, 1923, under Mr. Hugh Lett. On examination a pouch which contained half a drachm of fluid was found. The opening of the diverticulum was seen with the urethroscope to be situated in the posterior urethral wall.

Injury as a Factor.—This follows immediately on the preceding paragraph, for as trauma is probably a factor in the female, so it may be in the male. Watts and Sisk have reported cases of acquired diverticula following urethral rupture. Operations and false passages may also be followed by the formation of diverticula, an example being obtained from the Pathological Institute.

Necropsy 116/1921.—Male, age 66. Died following an operation for duodenal ulcer. The mid-penile urethra showed scarring. Posteriorly, in the region of the bulb, was found a smooth, lined pouch, 1 cm. in depth; it was directed downward, and was adherent to a linear scar in the skin of the perineum. The explanation of the formation of this pouch is that an external urethrotomy had been performed behind the stricture. The obstruction to micturition consequent on the stricture was not of such a degree as to result in fistula formation, and the skin wound closed. The deeper portion of the wound was distended each time the bladder emptied, and so failed to unite, and in due course became covered with a layer of epithelium.

Symptoms and Signs.—Clinically the cases are of two types:—

1. A patient presents himself with rather vague and indefinite symptoms, and a diagnosis can only be made by means of the urethroscope.

2. He complains actually of a swelling at some point along the urethra.

These will be illustrated by the following examples.

Type 1.—*Case* 3.—A railway clerk, age 22, was admitted to the London Hospital, in 1922, under Mr. Hugh Lett. He had suffered from no previous urethral disease.

HISTORY.—His complaint was that for three years, although micturition was free and normal, it was followed by an annoying dribbling of urine in drops, which caused him most inconvenience during the winter. During the preceding year the trouble had been more marked and accompanied by a slight degree of increased frequency of micturition.

EXAMINATION.—Diagnosis was made by the urethroscope, when a pouch was

seen on the floor 1½ in. in front of the triangular ligament. It extended posteriorly and just below the urethra, the wall separating the two being thin, for the air-distended pouch ballooned into the lumen of the urethra.

Fig. 38 shows an X-ray picture of this pouch distended with sodium bromide.

Type 2.—*Case* 4.—A pensioner, age 63, was admitted to the London Hospital in 1916 under Mr. Russell Howard. He complained of a swelling in the perineum.

HISTORY.—Two years previously he had noticed a swelling, which increased until it attained the size of a hen's egg. It then burst and discharged clear fluid. This sequence of events had recurred, and a similar swelling had now appeared for the third time. It was not tender, but there was a burning pain at the site after micturition. During the week preceding admission there was considerable difficulty in micturition and the swelling increased enormously in size.

EXAMINATION.—Situated in the perineum was a cyst the size of a large cocoa-nut which extended into the perineum, pushing the testes before it. The temperature and pulse were normal.

OPERATION.—The patient was placed in the lithotomy position. A mid-line perineal incision was made and deepened until a smooth-walled cavity was opened. One pint of clear urine was evacuated. On further examination the cavity was found to communicate with the urethra; the communicating orifice was cauterized and sutured. The scrotal tissues were united with catgut to obliterate the cavity, and the perineal wound was closed.

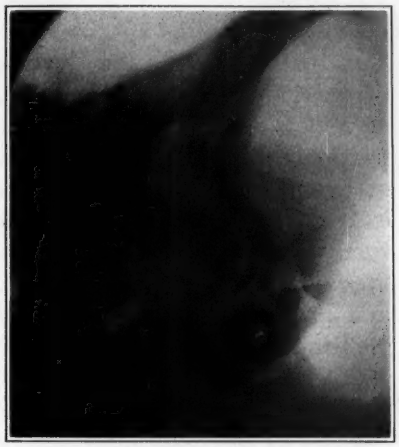

FIG. 38.—Radiogram showing congenital pouch distended with sodium bromide. (*M. H. Jupe.*)

I have endeavoured to trace this patient, but without success.

The symptoms may be modified by the onset of complications, such as inflammation giving rise to increased frequency and painful micturition, with a discharge of purulent urine when the pouch empties. The presence of stones has been already noted; an example was found amongst the pathological records. A male, age 49, was admitted with and died of hyperpiesis. During the routine pathological examination brown calculi, up to 0·3 cm. diameter, were found in the dilated urethral crypts. (*Necropsy* 233/1921.)

It is with pleasure I record my thanks to Mr. Hugh Lett, the Director of the Genito-urinary Department, for his help in the preparation of this article, and to Professor H. M. Turnbull for advice concerning the pathological specimens. Mr. Russell Howard and Mr. E. C. Lindsay have very kindly permitted me to use their cases.

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THE TECHNIQUE OF EXTRAPLEURAL THORACOPLASTY.*

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HISTORICAL.

The birth, growth, and development of an idea or project is always a matter of great interest. For the surgeon, the evolution of a new type of operation or a new method of attack on a disease has a very special appeal. This is particularly so when the earlier efforts give promise of success, and the process of evolution can be followed until it reaches the stage of simplification and exactitude of the essential principles, at which, for a time, it remains comparatively stationary. During the last three and a half decades the operation of extrapleural thoracoplasty has passed through its period of immaturity and has reached that of adolescence, with a fine record of success that augurs well for its future and for its more extended use.

The credit for the conception of the idea belongs to Quincke and to Carl Spengler. They recognized the mechanical difficulties associated with the healing of the lung, and especially of cavities therein; and that to overcome these difficulties mobilization of the chest wall was necessary. To this end they, in 1888 and 1890 respectively, advocated multiple small rib resections. Spengler gave to this principle the name 'extrapleurale thoracoplastic'. Turban, in 1899, carried this idea somewhat further, resecting portions (totalling 65 cm.) from six consecutive ribs. The first decade was therefore a period of very slow development.

During the earlier years of the twentieth century no further advance was made, though Garré and Quincke attempted a modified thoracoplasty for hæmoptysis. In 1907, Friedrick, operating for Brauer, did the first operation which has become known by their joint names. This consisted of a decostalization of the side of the chest. It was extensively practised for a time both by Brauer and Friedrick and by Sauerbruch. The operation had a very high mortality, because the removal of all rigidity from one side of the thorax gave rise to paradoxical movements of that side and to a to-and-fro flapping of the mediastinum. The effect of these is deficient ventilation of the lung, imperfect aeration of the blood, and serious disturbance of the heart which may lead to heart failure.

Wilms, recognizing that the dangers of the Brauer-Friedrick operation were due to the loss of support caused by the complete removal of the bony framework of the chest, devised (1911) the operation which goes by his name. He resected 2 to 4 cm. of the posterior parts of the first eight ribs through a paravertebral incision, and, later, the costal cartilages of the first five through

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* Partial thoracoplasty, in conjunction with or independent of artificial pneumothorax, is not under consideration.

a parasternal incision. The upper ribs, being thus detached, back and front, were free to drop down and inwards and to become approximated to the mid-line. The collapse so produced, though far from complete, proved most efficacious.

It is, however, to the acumen of Sauerbruch that we owe the operation as it is almost universally done to-day by those who practise thoracoplasty. He recognized that the all-essential factor in the production of unilateral collapse of the one side of the chest wall is the excision of a portion of almost all the ribs on that side, always up to and including the first, *as close* to the transverse process of the vertebræ as possible. When this is done, no operation on the front of the chest is, as a rule, necessary. This operation is known as 'Sauerbruch's paravertebral extrapleural thoracoplasty'. Brauer and Friedrick have abandoned their original method, and they now obtain collapse by an operation very similar to that of Sauerbruch. The only essential difference lies in the amount of bone removed.

Whilst there is agreement among the surgeons on the general principles of the operation, there are several differences of opinion on the individual details of the technique. These it is proposed to indicate.

TECHNIQUE.

Preliminaries.—The patient should be kept quiet in bed for ten days before the operation. It is most essential that there should be no recent complicating feature, such as a coryza, however mild, or diarrhœa, etc. Every effort must be made to have the lungs as free from secretion as possible. This is done by expectorants, and by posture when such is of assistance in the individual case. It will as a rule be many hours after the operation before the patient is able to expectorate; therefore the clearer the lungs are before the start, the less the danger.

The author gives his patients a course of tablets of suprarenal extract for ten days, but it is quite an open question if this has any real value. The rest of the preparation is the same as for any other operation. Brunner recommends a course of bromides; J. Alexander refers to the use of digitalis if the heart is weak.

Anæsthetization.—The fear of pulmonary complications and of further damage to an already diseased lung has resulted in establishing a considerable degree of antagonism to the use of general anæsthetics. A few years ago, most of the operations of thoracoplasty were done entirely under local analgesia. At the present time there are still some (viz., Brauer and Wendel) who maintain that the local method of anæsthesia is the only permissible one. Most surgeons, however, are beginning to realize that the danger of shock resulting from the intense strain of consciousness during the operation may be as serious as the risks of a general anæsthetic. Holding, personally, very strong views on this, it is gratifying to find so great an authority as Brunner making the following statement: "General anæsthesia has undoubtedly great advantages over local. The psychical shock of the operation, which is a very important feature in operations done without loss of consciousness, is greatly diminished by general anæsthesia. We have repeatedly convinced

ourselves that the general condition of the patient is unquestionably better after general than after local anæsthesia. The difference shows itself above all in the condition of the pulse."

A few surgeons, among them Archibald, Gravesen, and the author, use a combination of local and general anæsthesia. The majority use local anæsthesia when there is much sputum (Sauerbruch, if over 30 c.c. per diem; Brunner, if over 20 c.c.; Bérard, if over 60 to 80 c.c. or the patient is dyspnœic). If there is but little sputum they use ether.

The local anæsthetic used is novocain with adrenalin hydrochloride; but Bérard prefers anacain, which renders the tissues anæsthetic for thirty-six to forty-eight hours. It must be remembered that novocain is a poison, and that occasionally patients show an idiosyncrasy to it. It was for this reason that Saugman used to test the effect of it on his patients beforehand. The injection of 150 c.c. of a 0·5 per cent solution is regarded by Sauerbruch as safe; he does not exceed 200 c.c. Some surgeons, however, such as Lorey and Bull, use double the quantity. The combination of morphia with novocain increases the dangers, and for this reason Sauerbruch and Jessen limit also the morphia to $\frac{1}{6}$ gr. The author finds that by the use of general anæsthesia with the local considerably less of the latter is necessary, and now never uses more than 60 c.c. of a 1 per cent solution.

When a general anæsthetic only is given, deep anæsthesia is required, according to Brunner, to abolish the reflexes. Ether is, as a rule, preferred, but sometimes nitrous oxide and oxygen are used. Brunner quotes Spengler's investigations in 1903, which showed that ether is less deleterious for phthisical patients than chloroform. This is not altogether the experience of the author, who, while recognizing fully the dangers of both anæsthetics, prefers chloroform for the very light anæsthesia required, supplemental to the local, in order to keep the patient asleep during the operation.

The question of post-operative pain is of great importance, as on the absence of this depends so much the ability and the willingness of the patient to cough and to bring up the accumulated expectoration. It is for this reason that the author injects into the neighbourhood of each nerve 5 min. of absolute alcohol, so as to obtain an anæsthesia which will continue until the healing processes—including the rounding off of the cut ends of the ribs—have become complete. Nyström crushes the nerves and injects alcohol into them. Others, including Jessen and Schreiber, also Sauerbruch in those cases which have a very thickened pleura, resect from 1 to 2 cm. of the nerve. Experience has shown that paralysis of the lower intercostal nerves produces only very rarely serious consequences on the abdominal wall; but Brauer, because of the possibility of paralysis, insists that the nerves shall be preserved. Oehlecker has shown that, after nerve resections in operations for empyema, the paralysis may lead to a ventral hernia.

When the operation is done under local anæsthesia entirely, the Schumacher technique is undoubtedly the best.

The Number of Stages.—This is another somewhat vexed question, and opinions differ considerably. Sauerbruch does the operation in two stages, but occasionally in one, three, or even four. Nyström used to do it in one, but now invariably operates in two stages. Bull and Jacobaeus and Key

believe in the two-stage operation; Wendel and Gravesen in the one-stage. Jehn does it in one stage if the heart is strong and the mediastinum is fixed. Undoubtedly much must depend on the condition of the patient and the character of the disease. When the operation is done in two stages, ribs 11 or 10 to 5 inclusive are removed at the first stage, and ribs 4 to 1 at the second.

The effect on the mind due to the strain of anticipation and of the actual operations themselves must unquestionably be infinitely greater if there are two major operations as compared with one, especially if both are done under local anæsthesia. The patient has scarcely recovered from the shock of the first when he has to endure that of the second. This is particularly the case since, in the two-stage operation, the sooner the second stage is done after the first, the better will be the results so far as collapse is concerned. Too long a wait after the first operation will allow the re-formation of bone from the periosteum which has been stripped off and left behind, and the success of the operation becomes jeopardized. Nyström, to overcome this difficulty, removes the periosteum with the ribs. The interval between the two stages is usually two or three weeks. Another objection to the two-stage operation is raised by Gravesen, who considers that the second interferes with the satisfactory healing. Jacobaeus and Key, however, do not agree with this.

Against the one-stage operation is the increased risk due to the greater magnitude of the undertaking; the longer time taken, and the greater wound exposure; the greater and more sudden collapse of the lung; and the risk of more serious interference with the mediastinum and heart.

J. Alexander records the advantages of the two-stage operation as: (1) Less shock and less sudden changes demanded of the circulatory and respiratory mechanisms, which are enabled to adjust themselves gradually. (2) Fewer toxic products are pressed into the general circulation to endanger latent lesions in the better lung; therefore two stages are important if the better lung is under suspicion of activity. (3) The first stage usually causes enough rest and relaxation of the lesions to bring about a definite clinical improvement.

He states the advantages of the one-stage operation to be: (1) Much preferred by the patient. (2) Risks of embolus and of anæsthetic poisoning and of wound infection run once only. (3) If wound infection should occur, the whole lung has been compressed—no need to postpone a final stage of the operation. (4) Muscles are sectioned once only. (5) More even lung compression and so less irritation of the cavities and fewer chances of lung hæmorrhage. The scapula fits more evenly against the lung (Gravesen).

Brunner states that the one-stage operation is preferable, not only as regards operative technique, but also from the mechanical standpoint. He emphasizes, however, that it should be done only in fever-free cases with slightly progressive or stationary fibrotic tuberculosis with small cavities and little sputum; that the general condition must be good and the circulatory system sound.

Baer considers the one-stage operation as the ideal; but contra-indications to it are, imperfect closure of the glottis on coughing, and excessive displacement of the mediastinum associated with maximum compensatory emphysema of the opposite lung. Hanke states that thoracoplasty, whether done in two

or more stages, is not an operation for a patient seriously ill. If the mediastinum is not sufficiently fixed, paradoxical respiration with great disturbance of breathing and interference with expectoration must be expected after the one-stage operation.

Much depends on the condition of the patient and on the character of the lung lesion. Sauerbruch and Brunner operate in one stage on those patients only who have a very chronic fibrotic lesion. The author is not so precise in his limitations. His attitude is as follows: The operation should be done in one stage if possible, but always having the greatest regard to the safety of the patient. If the patient's general condition is good, if there is no difficulty in respiration when on the table, and the colour is satisfactory, if the sputum is not excessive and likely to flood the bronchial tubes when the lung collapses, and the disease is not acutely active with considerable complicating secondary infection, then the operation is started off with the complete incision as for a one-stage operation. If there is any doubt, however, as to the patient's ability to tolerate the complete rib resection, the operation is begun as though for a two-stage undertaking. When this first part is completed up to and including the rib excision, the condition of the patient is considered, and if this appears to justify it, the second stage is carried out.

The Skin Incision.—The Sauerbruch paravertebral incision for the removal of parts of ribs 11 to 1 in one stage, starts above, just below the upper edge of the trapezius muscle, extends down between the vertebral border of the scapula and the spines of the dorsal vertebræ (the arm being held close to the side) at a distance of 3½ or 4 in. from the spines. When the incision reaches the 11th rib (or the 10th if ten only are being removed), the incision curves abruptly outwards to the posterior axillary line. When the operation is done in two stages, for the first, the lower part of the incision is used, starting above over the 4th intercostal space. At the second stage the upper part of the incision is modified by being curved outwards along the 4th rib.

Brauer amplifies the vertical incision by a transverse one along the 1st or 2nd rib. This he regards as especially useful when doing the second stage in a two-stage operation. Wendel, operating in one stage, starts his incision over the 4th rib. To reach the upper four ribs he tunnels under the trapezius. He claims that this is quicker, requires less anæsthetic, and prevents such free division of the vascular muscle.

The Number of Ribs Resected.—Portions of the first ten ribs are almost invariably resected. The one exception is the procedure of Brauer, who occasionally leaves the first rib undivided when there is much retraction of the apex of the lung. The importance of freeing this rib is, however, great, because as each rib is slung on to the one above by the intercostal muscles, so are they all eventually slung on to the first. After resection of portions of the first ten ribs, the compression of the lung is dependent on the alteration of the position of the ribs in three directions: (1) The cut ends are approximated; that is to say, the cut freed end of the rib approaches to the spine. (2) The cut freed ends of the ribs drop down a distance equal to one, and often two vertebræ. (3) There is a bucket-handle action which tilts the main part of the rib through part of an arc of a circle, bringing the centre of

the curve of the rib nearer to the middle line and at a lower level. This change, which was a very striking one after the Wilms operation, is still present in the paravertebral resection by reason of the yielding of the costal cartilages to torsion. Both the second and the third of the above-described movements are limited if the first rib remains intact.

Saugman did not excise any of the 11th rib. Sauerbruch, Brunner, and most of the other surgeons do. They claim that by removing some of the bony support of the diaphragm that muscle is relaxed, and, rising into the chest, increases the collapse of the base of the lung. The author does not agree that division of the 11th rib is necessary. Ample collapse can be obtained without this; it is at the apex rather than at the base that the collapse does not always fulfil all requirements. Moreover, the retention of some of the supports of the diaphragm is advantageous, in that this muscle exercises a steadying effect on the lower part of the mediastinum, including the heart.

Resection of the ribs is almost always done from below upwards (except occasionally only when the disease is almost entirely basal). This order of resection enables the lower part of the lung to collapse first, and so prevents aspiration of infected secretions from the upper into the lower lobes.

The Amount Resected.—All are agreed that the part of the rib resected must extend up to the transverse processes of the vertebræ. The actual length of rib excised is of less importance, except that if too much is removed there is the risk of those dangers associated with the original Brauer-Friedrick operation (viz., mediastinal fluttering and heart failure). On an average 2 to 4 cm. only is removed from the 1st rib, 6 to 8 cm. from the next three, from 10 to 16 cm. from the next four, and then again less from the lower two or three. The total amount excised by Sauerbruch averages 110 cm. Jehn and Brunner excise somewhat less; Brauer and Friedrick average 125 cm.; the author 120 to 130 cm.; Jacobaeus and Key 140 cm.; and Bull from 120 to 180 cm. Brauer maintains that all that part of the ribs underlying the scapula should be removed. It is most important for efficient collapse that, after the operation, the scapula should sink right in so that it lies at a deeper level (i.e., more anterior) than the posterior surface of the transverse processes. Owing to the changes in position of the freed end of the ribs, already mentioned, this falling in will take place even if the whole of the ribs underlying the scapula are not excised.

DETAILS OF THE AUTHOR'S TECHNIQUE.

Anæsthetization.—Previous to the start the patient must have been encouraged to cough up all the sputum possible. Omnopon ($\frac{1}{3}$ gr.) is given hypodermically twenty minutes before the local anæsthetization is begun. This anæsthetization is done in bed an hour before the operation. It is considered inadvisable to have the patient in the theatre and on the table all this extra time, as it increases the period of anticipation, and the operating table is uncomfortable, especially for a patient who is at all emaciated.

The anæsthetic used is novocain (1 per cent) to which has been added adrenalin hydrochloride (1–1000) 12 drops to 60 c.c. of the solution. The

line of the skin incision 3½ in. from the mid-line is first anæsthetized, starting over the 10th rib and working upwards to beyond the 1st rib; then from the starting-point along the course of the 10th rib to the posterior axillary line. Two syringes are then used: the one of 2 c.c. capacity and the other of 1 c.c. The smaller is filled with absolute alcohol, and the larger with novocain. The latter is fitted with its needle (very fine and long), which is driven through the anæsthetized skin inwards and backwards into the 10th interspace, a little novocain being injected all the time. The rib is sought for and touched so as to locate it and gauge its depth; when found, the needle is then redirected into the intercostal space below, and the rest of the novocain injected between the two ribs. The syringe is detached from the needle, which is left *in situ*, the 1-c.c. syringe is attached to it, and 5 min. of absolute alcohol are injected into the interspace, the needle being slowly withdrawn a few millimetres as the alcohol runs in. The 1-c.c. syringe is in turn detached, the needle being still left in the tissues for the time being to mark the space treated. Another needle is fitted to the 2-c.c. syringe, refilled with novocain, and the process is repeated in the space above. When this space has been anæsthetized and the syringe detached from the needle, the first needle is withdrawn for use for the injection of the next space above. This process is repeated until the 1st intercostal space has been anæsthetized. Novocain only is injected above the 1st rib. Finally, a few syringefuls of novocain are injected into the subcutaneous tissues and the muscles along the lines of the incision.

Just before the scheduled time of the operation, the patient is taken to the theatre and arranged on the table. He reclines on the sound side with the shoulders raised and the pelvis and buttocks well supported. A nurse steadies the arm on the affected side. Morphia ($\frac{1}{6}$ gr.) and atropine ($\frac{1}{120}$ gr.) are given.

The general anæsthetic is not started until the surgeon is absolutely ready, so that he can begin the moment the patient is sufficiently under. As the tissues have all been anæsthetized it is not necessary, nor is it desirable, to get the patient deeply under. The lightest anæsthesia only is requisite. As stated above, the author prefers chloroform for this light narcosis.

Operation.—Sauerbruch's paravertebral incision is used. If the general condition is good, if the cardiac muscle has not been seriously impaired by toxæmia, if the colour is satisfactory and the respirations under the anæsthetic are free and 'comfortable'; if, that is to say, there is every indication that the patient will tolerate well the complete operation in one stage, then the incision is begun above the 1st rib, carried down to the 10th, and then outwards to the posterior axillary line. The skin and the muscles are divided down to the ribs. The muscles are: the trapezius above and the latissimus dorsi below; deep to the trapezius is the rhomboideus major, beneath which again is the serratus posticus superior; below the rhomboideus is the vertebral aponeurosis, and below this again some of the fibres of insertion of the serratus posticus inferior will be cut. The division and separation of these muscles exposes the longitudinal fibres of the accessorius; the outer border of this muscle is defined, the outer fibres are detached from the ribs and displaced inwards. The posterior parts of the ribs and intercostal muscles are now exposed.

It is most important to ensure that all bleeding points have been secured;

all artery forceps should be replaced by ligatures, as the forceps are apt to be dislodged during the subsequent movements necessary for stripping and excising the ribs. The skin and the muscles should be protected as completely as possible by gauze secured to the wound.

The next step is the stripping of the periosteum from that part of the ribs which it is proposed to excise. In order to get a fuller exposure of the field of operation, the nurse draws the arm on the affected side forwards and upwards towards the head; this carries with it the scapula and the attached muscles. The periosteum is incised with a knife along the dorsum of the rib; it is then stripped off the dorsum by short vigorous strokes with a square-ended periosteal elevator; just beyond the angle the periosteum is detached from the upper and lower borders of the rib as well. A Doyen elevator (either the ordinary one, or one with the elevator set at a more obtuse angle to the shaft) is slipped round the rib between it and the periosteum, and the bone is stripped back to the transverse process. For the separation of the periosteum and intercostal muscles from the anterior part, the author uses his own elevator (*Fig.* 39), which is easily placed in position between the bone and periosteum in front of the angle, and can then be driven forwards, out of sight under the muscles if necessary, without risk of damage to any other tissues. The 10th to the 5th ribs inclusive are thus treated, and in this order. As each rib is freed, the lung and soft tissues retract away from it, leaving a space which must be gently packed with gauze rung out in hot saline solution.

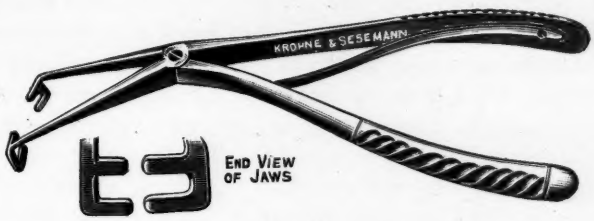

FIG. 39.—Author's raspatory.

The desired length of each of these ribs is now excised, starting again with the 10th. Each rib in turn is cut through with stout long-handled bone forceps as close to the transverse process as possible. The rib, as it is cut, is seized by the assistant with lion forceps, and the cut end lifted out of the wound. The ring of the author's bone forceps is slipped on to the rib and is run along it as far forwards as the periosteum has been stripped (i.e., until it meets the resistance of the unseparated intercostal muscles); at this point the bone is divided and removed. These forceps (*Fig.* 40) ensure that the cutting jaws of the forceps stay in contact with the rib; they allow of the division of the bone with absolute safety, out of sight if necessary.

FIG. 40.—Author's bone forceps.

The condition of the patient is reported on at this stage of the operation.

If everything is satisfactory, the excision of the required amount of the upper four ribs can be proceeded with. The 4th and 3rd ribs are dealt with in the same way as the lower ones. The 2nd is then excised; for the separation of the periosteum of this rib, Doyen's raspatory only is used. The portion of bone having been removed, access to the 1st rib is easier. As clear a view as possible must be obtained. The posterior edge is cleaned, then the upper surface, and then the lower. The blunt point of a Friedrick's raspatory is now passed round the inner margin—all the time keeping in closest contact to the bone—and the periosteum is freed over a distance of about 2½ cm. The raspatory is withdrawn, and a narrow copper spatula, with one end curved back as a hook, is passed along the under surface and round the inner edge. This spatula protects all adjacent tissues from injury while the rib is cut with blunt-point forceps. As soon as the 1st rib has been cut, no more anæsthetic is given.

The vertebral end of each rib is examined and, if necessary, pointed or rough particles are cut away with gouge forceps. All loose tags of muscle are cut away, and all bleeding points ligatured. The muscles are then accurately sutured in two layers with catgut, and the skin incision is closed, except at the lowest point, through which a large drainage tube is inserted extending upwards some four inches under the superficial muscles.

The dressings are applied and fixed with a strong broad many-tailed bandage with shoulder straps. It is of the utmost importance that this bandage shall be applied firmly, so as to give adequate support to the collapsed side of the chest and to the heart, but not so tightly as to compress and restrict the sound side. To obviate this restriction Jacobaeus and Key make, before the operation, a plaster cast of the sound half of the chest; after the operation, they fix on this half-jacket and apply the bandage over the dressings on the side of the operation and over the plaster jacket on the other side. The author has not found this to be necessary. The arm must be included in the bandage. So little anæsthetic should have been given that the patient is recovering consciousness before leaving the theatre, and is aware of his surroundings by the time he is settled back in bed.

The amount of rib removed is from 120 to 130 cm. This total is made up as follows: 1st rib, 4 cm.; 2nd rib, 8 cm.; 3rd rib, 12 to 13 cm.; 4th to 8th ribs, 15 to 17·5 cm.; 9th rib, 12 to 13·5 cm.; 10th rib, 9 to 10 cm. The time taken by the author for the complete one-stage operation is forty minutes. Sauerbruch, with his big experience and special assistants, can do either stage in twelve to twenty minutes. Alexander says: "Jessen can do the complete operation, ribs 11 to 1, in twenty minutes. Bull's average time, with one or two assistants, is one hour. Either stage of the operation can be performed handily by a well-trained team in forty minutes".

After-treatment.—The patient is propped up in the semi-recumbent posture as soon as the recovery of the cardiovascular tone justifies this. Immediately on his return the patient is given a rectal injection of saline. This is repeated six-hourly until the next morning. Plain water or water containing sodium bicarbonate is allowed. There is usually so little shock that stimulants are not required, and there is usually so little pain that anodynes are not needed. Omnopon (⅓ gr.) is given hypodermically the first

night to ensure comfort and to help sleep. Should pain be severe, morphia ($\frac{1}{6}$ gr.) is given, and is repeated when necessary. The patient is encouraged to cough after the hypodermic of omnopon has been given, and again the next morning. If it is impossible then owing to the pain, and there is the fear of complications from retained secretions, it is advisable to give another hypodermic so as to ease the pain and enable the patient to bring up the sputum.

It is more than probable that the dressings will be 'through' the first evening; they must not, however, be changed, but must be 'packed' only, i.e., fresh dressings are placed over the bandage, *which must in no way be disturbed.* The first dressing is done twenty-four hours after the operation. Very great care is required to avoid pain when turning the patient, and the serious disturbances which may arise when the support is removed from the collapsed side of the chest. The pain is occasioned when rolling the patient over on to the sound side; the cut ends of the ribs are certain to shift and to irritate the nerves and the pleura. The rotation of the patient should be done entirely by means of the draw-sheet and before the bandage is disturbed. Fresh draw-sheets and everything likely to be required must be at hand, so that the bed can be put in order with the one set of turnings. Arranged on a towel at hand must be the fresh set of dressings—gauze and wool complete—ready to be picked up and placed on the wound. While the patient is turned on to the sound side, the arm is supported by a nurse so as to avoid all drag on the divided muscles. The bandage is undone and removed with the dressings. The tube is taken out, the wound is lightly swabbed, the prepared dressings are applied and held in place while the draw-sheet and the one set of tails of the bandage are tucked under the sound side. The patient is now rolled back by the old draw-sheet, while being supported on the other side by the clean one, and the bandage is applied as quickly as possible. The arm is this time secured by a separate sling and supported under the elbow by a pillow. The bandage should not be disturbed again until the stitches are taken out.

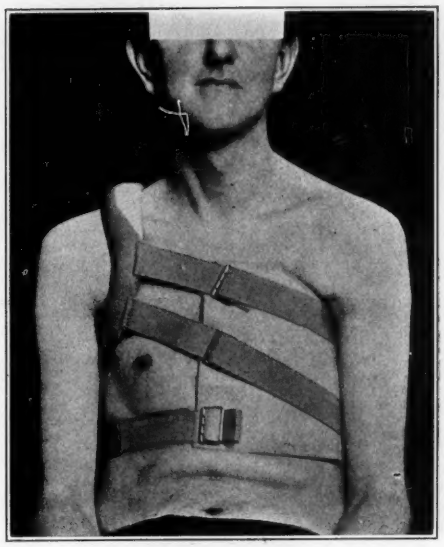

FIG. 41.—Support used by author after thoracoplasty.

Once the wound is soundly healed, the many-tailed bandage can be dispensed with. Support for the collapsed side is, however, very essential for the next few months, until such time, at any rate, as the chest wall has become fixed by the new bone formation, which replaces the ribs removed and at the same time ankyloses the adjacent bones to each other. This support should be in the form of a pad, pressing especially on the axillary surface and over

the scapula on the side of the operation; the straps from the pad pass to a shoulder-piece looped round the opposite shoulder and axilla, as in *Fig.* 41.

Rest in bed for three weeks at least after the operation is essential. After that period, exercise can be started with extreme care if the condition of the opposite lung, of the temperature, and of the pulse justify it. Sanatorium régime should be carried on all the time.

After-results.—The suddenness with which symptoms change is often dramatic. One of the author's patients lost completely, from the moment of the operation, the cough and sputum which had been an ever-present reminder for over two years. Another lost with equal abruptness the intense stretching drag on the trachea which produced on coughing a sensation of

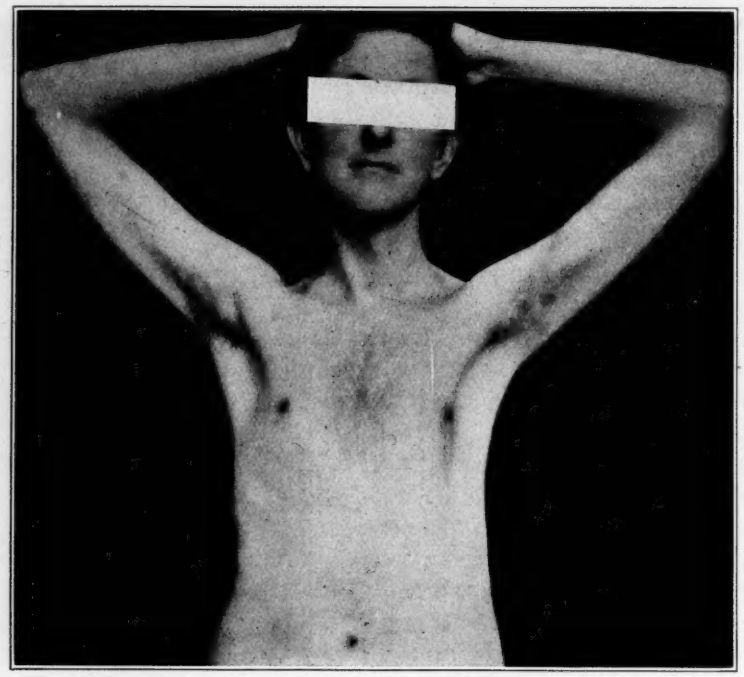

FIG. 42.—*Case* 1. Age 31. Six months after thoracoplasty.

suffocation. The loss of cough and expectoration is not, however, always so abrupt. The sputum may even be at first increased, but diminish rapidly later. Dyspnœa is occasionally observed during the first week or two. Occasionally pain down the arm, in the shoulder, and in the side of the chest, due to drag on the brachial plexus, is a troublesome feature for a few days. Sometimes the pain is along the course of one intercostal nerve which has escaped the alcohol and is being pressed on. As a general rule, however, it will be found that the post-operative discomforts are, like the shock, surprisingly little considering the character and severity of the operation.

The signs may disappear with equal rapidity, but in some cases the lung, particularly the upper part of it, seems filled with coarse or fine moist sounds which may persist for months. These may be present without there being

any cough or sputum. As Alexander says, "*The compressed lung, even after its disease has become wholly arrested, presents the physical signs of active tuberculosis*". And again later, "For years the compressed lung, even in the total absence of catarrh and sputum, may be full of coarse and fine râles and a variety of bizarre noises".

If movements of the arm are begun soon enough, there should be practically no limitation of any normal movement (*Fig.* 42). There is remarkably little deformity of the body; none at all need be visible when the patient is dressed. The shoulder girdle is unaffected, but occasionally there is some lowering, and at times even raising, of the shoulder. Owing to the separation of muscle attachments to the posterior parts of the ribs and of some of the ligamentous bands, there is at first weakness of the muscles on that side of the spine, and consequently a tendency to scoliosis concave to the sound side. In chronic cases, however, there has been, prior to the operation, some scoliosis concave to the affected side. The one, therefore, tends to neutralize the other.

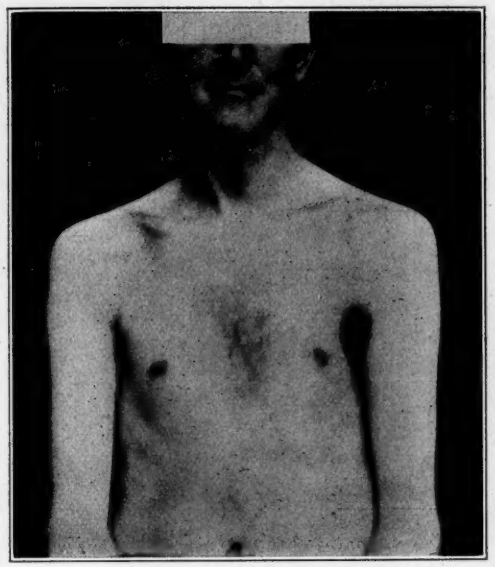

FIG. 43.—Same case as *Fig.* 42.

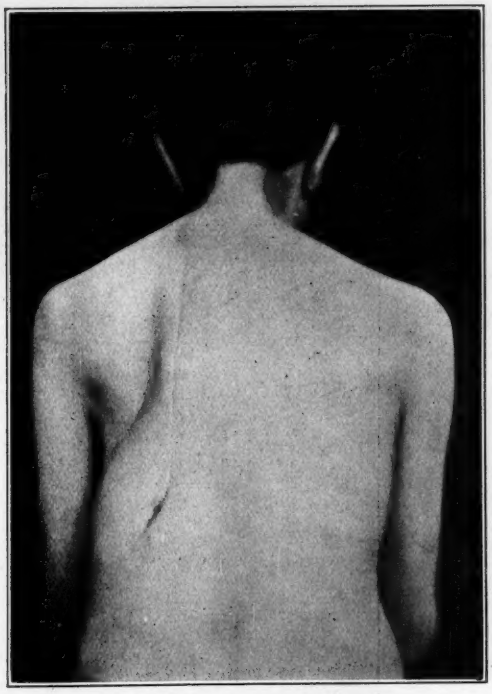

FIG. 44.—Same case as *Fig.* 42 viewed from behind.

Viewed from in front, the patient will exhibit considerable flattening of the affected side, while the junction of the axillary fold and the arm, instead of being pointed, is rectangular (*Fig.* 43). Viewed from behind, it will be seen that the scapula has sunk so that its dorsal surface is on a level with the transverse processes. There is also a hollow round the lower angle and the axillary border of the scapula (*Fig.* 44).

Fig. 45 shows the X-ray appearances of a case before operation, and *Figs.* 46–48 are skiagrams taken after operation.

FIG. 45.—*Case* 1. Skiagram taken before operation.

FIG. 46.—*Case* 1. Skiagram taken six weeks after thoracoplasty.

Results of Individual Surgeons.—

Sauerbruch, out of 381 cases, had a mortality during the first week of 14 per cent; 35 per cent were practically healed. Brunner, out of 117 cases, had an 11 per cent mortality; 41·9 per cent were practically healed. Gravesen, out of 96 cases, had an 8·3 per cent mortality; 44·8 per cent were much improved or practically healed.

The author has done 25 thoracoplastic operations for bronchiectasis and tuberculosis: 20 of these were for the latter disease. Of this 20, 8 were done between 1913 and 1915 by the author's modification of the Wilms type of operation. One died of pneumonia 6 weeks after the first stage; one a year

FIG. 47.—*Case* 2. Age 46. Skiagram taken eight weeks after thoracoplasty (anterior view).

after the operation; one, who from a bedridden invalid had been restored so that she could lead an active life, died 3 years later from extension in the originally sound side, following influenza. Three (one much improved and two clinical cures) were lost sight of 10 months, 1½ years, and 3½ years later. Two were alive and well 9 and 11 years respectively after the operation.

The later series includes the 12 cases operated on from four years to six months ago. Of these, one died immediately after the operation (this, the only immediate post-operative death, was complicated by a very rapidly recurring pyopneumothorax); one died 11 months after from tuberculous enteritis; one case, after doing excellently well for 3½ years, had influenza and developed a basal effusion on the 'sound' side which is proving resistant to treatment; one case has had extension of the disease in the opposite lung.

The remaining eight are all very greatly improved, and four of these are free from all symptoms.

Alexander has collected 1025 cases reported during the six years 1918–23. These show: Cured, 32 per cent; improved, 26 per cent; worse and early and late deaths, 35 per cent; miscellaneous, 7 per cent.

Preliminary Phrenic Evulsion.—

Sauerbruch recommends that the dome of the diaphragm on the affected side should be paralysed by phrenic evulsion prior to the extrapleural thoracoplasty, in order to test the 'sound' lung and its capacity to tolerate the

FIG. 48.—*Case* 2. Same case as *Fig.* 47 (posterior view).

strain which will be thrown on it by the major operation; also because the paralysis of the dome and its heightened position in the thorax increase the collapse of the base. Hans Alexander is also of the opinion that phrenic evulsion should precede thoracoplasty. Brauer considers this preliminary operation unnecessary and purposeless, as the test can equally well be done by an injection of tuberculin. The author's experience is that the collapse of the base of the lung is usually quite sufficient without the added paralysis of the diaphragm, and that the disturbance produced by this operation is scarcely sufficient to serve as a guide to the responsive capabilities of the 'sound' lung. Phrenic evulsion is undoubtedly of great value in certain cases in helping to improve the patient's general condition before the major operation, especially where there is a constant distressing cough due to irritation of the diaphragm. In all cases of tuberculosis complicated by effusion, the

diaphragm should be paralysed on the affected side so as to reduce the size of the intrapleural cavity.

Supplementary Operations.—

These are sometimes necessary when stiff-walled cavities in the apex of the lung interfere with the efficient collapse of the chest wall after thoracoplasty. Bull, to remedy this, practises apicolysis, either at the time of the operation, or subsequently.

Brunner does not approve of apicolysis because of the danger of tearing the wall of the cavity, and of the consequent secondary infection. He considers that it is preferable to remove the anterior parts of the ribs overlying the cavity. Claus advocates that these cavities should be laid open.

In conclusion, I will quote the words of Lilienthal, who " considers that the marvellous improvement that takes place soon after the operation (of thoracoplasty) is quite extraordinary. Extrapleural thoracoplasty has the great advantage of fixation of the chest in addition to setting at rest the lung itself ".

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PYELOGRAPHY IN POLYCYSTIC DISEASE OF THE KIDNEYS.

By W. M. CARRICK, Hamilton, Ontario.

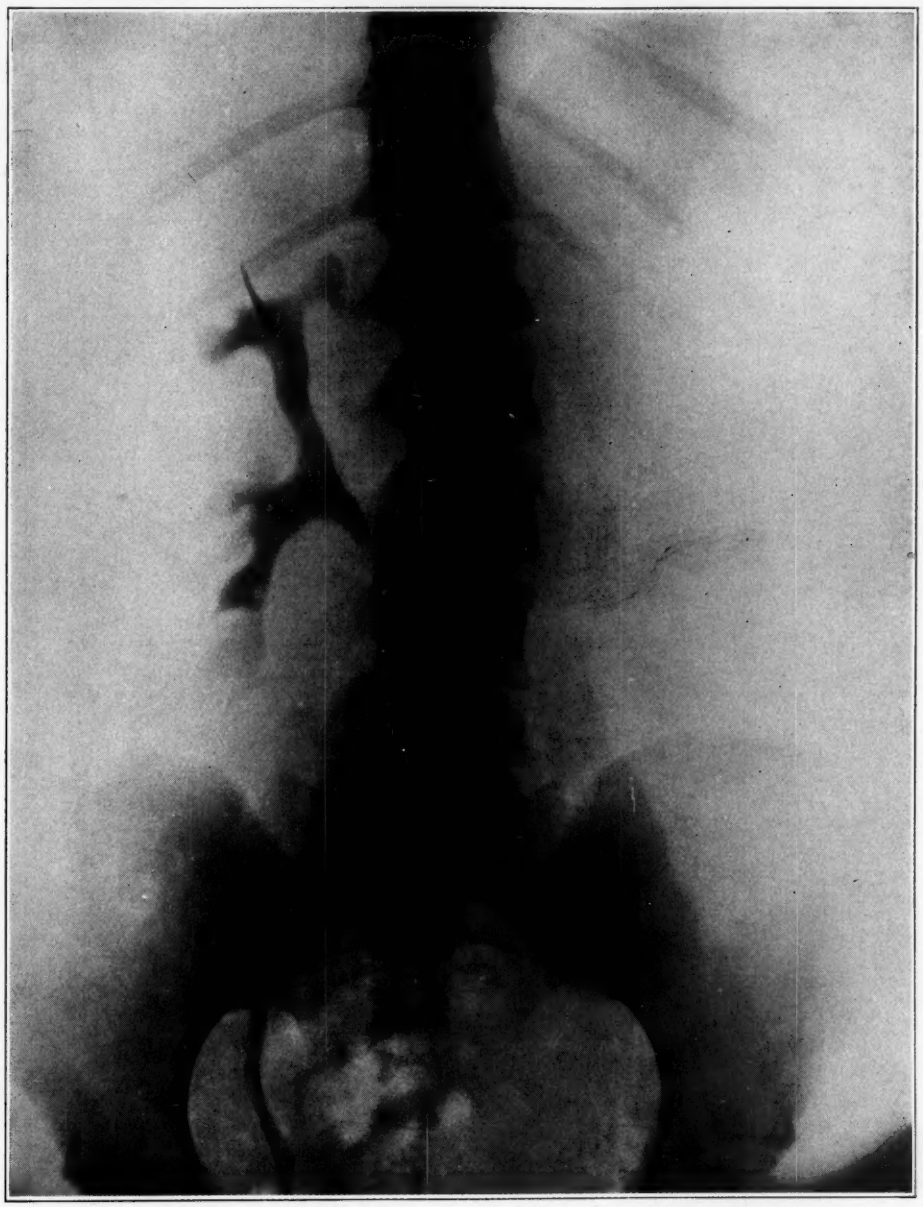

Fig. 49.—*Case* 1. Skiagram showing injection of left kidney.

In the October, 1924, issue of The British Journal of Surgery there appeared a very comprehensive article on polycystic disease of the kidneys,

with reports of five cases. The author had very little to say regarding pyelography in this condition, and I think the accompanying illustrations of two cases might be of interest to show the value of pyelograms in corroborating clinical findings.

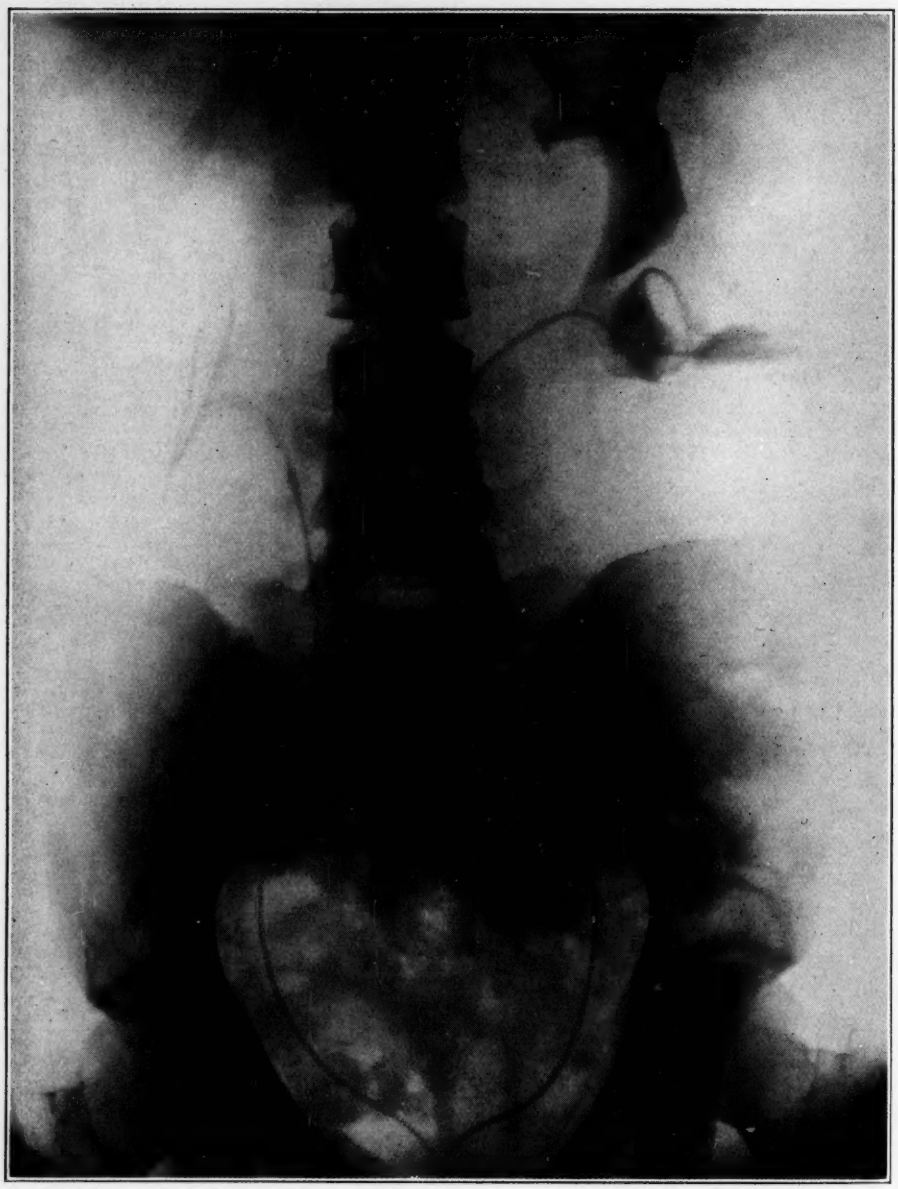

FIG. 50.—*Case* 2. Skiagram showing both kidneys injected.

In *Case* 1 (*Fig.* 49) the condition existed on both sides, but it was not considered necessary to inject the right kidney. It will be seen that the

right ureteral catheter has doubled on itself and coiled in the kidney pelvis, denoting considerable enlargement.

In *Case* 2 (*Fig.* 50), both sides were injected, the left kidney being imperfectly filled owing to rapid return flow of the opaque sodium iodide solution into the bladder.

Both were female patients; one 48 and the other 30 years of age.

Phenolsulphonephthalein efficiency tests were unsatisfactory in both cases, and the blood chemistry done in one case showed: urea nitrogen 49·4, creatin 3·105, sugar 0·070.

OBSERVATIONS ON THE ETIOLOGY AND TREATMENT OF CYSTITIS.

By H. W. B. CAIRNS, London.

There is a large volume of evidence to show that the bladder is highly resistant to infection by pyogenic bacteria. Rovsing[7] found that injection of virulent bacteria into the normal bladder did not produce cystitis. Panton[6] and others have shown that pathogenic bacteria could frequently be recovered from the urine of individuals, healthy and otherwise, who were quite free from inflammatory lesions of the urinary tract. In addition, there is indirect clinical evidence which points to the same conclusion, namely, the rarity of cystitis after the passage of instruments into the bladder. Thus, at the Genito-urinary Department of the London Hospital, in the last five years it is extremely doubtful whether any case of cystitis has occurred which could be ascribed to infection at cystoscopy. We admit that our technique is good, but we do not flatter ourselves that, during this period in which over 3000 cystoscopies have been performed, we have been able in every case to prevent bacterial infection of the bladder. It is, therefore, clear that in addition to bacterial infection some other factor is necessary for the production of cystitis.

This study was undertaken in order to determine the principles which govern the etiology of cystitis, and in order to find, if possible, some simple classification which would be of use in the investigation and treatment of the disease. The chief results may be summarized as follows: There were two main clinical types of cystitis; one in which the disease tended to clear up quickly, either spontaneously or with very simple treatment; and the other a type in which the disease became chronic. It was found that in almost all cases of the chronic group the cystitis was maintained either by a persistent infection from the kidney or by the presence of residual urine in the bladder.

No claim is made that these observations open up fresh ground; but the writer has found the conceptions developing from this investigation of great service in the management of urinary infections. Like Dr. Johnson's poet, "he feels what he remembers to have felt before, but he feels it with a *great increase of sensibility*". Among modern writers the influence of persistent kidney infections has been stressed by Kidd,[5] while Curtis[2] has shown the importance of residual urine in the production of cystitis in women; and both of these factors have been given their due in cystitis by Caulk.[1] The facts are, however, imperfectly dealt with in most of the current text-books; they are hidden amid lengthy descriptions of 'acid and alkaline cystitis', the morbid anatomical varieties of cystitis ('cystitis cystica', 'granular cystitis', etc.), the bacterial varieties of cystitis, and other questions of secondary importance. Judging, too, from our experience at the London Hospital, the

principles which govern the etiology of cystitis are not properly understood by many practitioners. These deficiencies can only be made good by a consideration of cystitis in terms of disordered function.

MATERIAL.

An examination was made of the records of the Genito-urinary Department of the London Hospital for the years 1921–24 inclusive. The following cases were excluded :—

1. Cases of tuberculous cystitis.
2. Non-bacterial cystitis due to chemical irritants.
3. ' Purpura of the bladder '.[4]
4. Cases of pyelitis in which, at cystoscopy, only the ureteric orifice and a small adjacent zone of the bladder wall showed signs of inflammatory change. These, although technically cases of pyelocystitis, are for practical purposes uncomplicated cases of pyelitis.
5. Cases labelled in the records 'slight basal cystitis', in which the urine was sterile and free from pus. It was considered that the evidence in these cases was insufficient to justify their inclusion. At cystoscopy the base or trigone of the bladder has normally a bright-red appearance due to its liberal supply of blood-vessels. In cases of prostatic disease, pregnancy, and cystocele, these vessels frequently become engorged, and the resulting appearance may resemble closely the redness of inflammatory hyperæmia. In general, however, it may be said that in the redness due to engorgement a careful examination will show that each individual blood-vessel can be distinguished, whereas when the redness is due to the hyperæmia which connotes cystitis the individual vessels cannot be seen—the surface of the trigone presents a homogeneous red blush.

When the above groups were excluded, 86 cases remained. The diagnosis of 'cystitis' in these cases rested on the evidence obtained from direct examination of the bladder, by cystoscopy in 83 cases, by suprapubic cystotomy in 1 case, and by necropsy in 2 cases. In the severe cases cystoscopy was not performed, save in exceptional circumstances, until the acute symptoms had subsided.

BACTERIOLOGY.

All cases had pus in the urine. The results of cultivation of the urine (*Table I*) showed an overwhelming preponderance of *B. coli* as the infecting organism, and the results are in accord with those of other writers.

Table I.—Organisms Cultivated from the Urine.
(No cultures were made in 14 cases.)

	Cases
B. coli alone	40
B. coli and *B. proteus* ..	2
B. proteus alone	3
Staphylococcus aureus ..	1
Staphylococcus albus ..	17
Cultures sterile	9
Total ..	72

In 35, or 41 per cent, of the cases, the clinical course indicated that the cystitis was secondary to infection of the kidney or kidney pelvis. In all the other cases it was impossible to determine accurately the source of the infection. Cystitis of the resolving type was associated with prostatitis in a few instances, but the relationship between these foci of infection was not clear.

CLINICAL TYPES.

The after-histories of 76 out of the 86 cases were traced. A preliminary study of the traced cases showed that they fell into two clearly defined groups :—

1. *Resolving Group.*—Twenty-one cases* showed a strong tendency towards spontaneous resolution. Many of them were already clearing up before they had had any treatment, and all of them were cured, within four to six weeks of their onset, by extremely simple forms of treatment, such as the administration of potassium citrate and large quantities of fluid by mouth.

2. *Progressive or Protracted Group.*—Fifty-five cases* showed a tendency to progress. None responded to simple forms of treatment. Many of them had lasted for years. In two cases the cystitis was followed by ascending pyelonephritis and death.

In seeking an explanation for this remarkable division into resolving and progressive types a closer examination of the progressive group showed that in all except one case—a case of solitary ulcer of the bladder—one or other of the following factors was present : either there was a persistent infection of the bladder from the kidney ; or the bladder infected was one which had been, prior to infection, the subject of disordered function. The influence of these factors on the chronicity of the cystitis was amply demonstrated by the success of treatment directed against them.

THE RETENTION FACTOR IN PROGRESSIVE CYSTITIS.

The type of derangement of bladder function which predisposes to chronicity in cystitis is the inability of the bladder to empty itself completely at each act of micturition ; that is to say, there is always a certain amount of residual urine in the bladder. This, which may be termed the 'retention factor', can be produced by a number of different conditions.

Out of the 55 cases of progressive cystitis there were 30 in which chronicity was due to the retention factor (*Table II*).

The appearance of the bladder and the clinical course in progressive cystitis varied according to the severity of the retention factor and the length of time through which it had been acting. Three main types could be distinguished : (1) *Fulminating type ;* (2) *Severe chronic type ;* (3) *Mild chronic type.*

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* These figures do not give the true relative frequency of the different types of cystitis, for many cases of the resolving type clear up so quickly on medicinal treatment that they are never sent to the urologist.

Table II.—Causes of the 'Retention Factor' in Progressive Cystitis.

	Cases
Spinal-cord lesion (injury)	1
Atony of the bladder; old spinal cord lesion	1
Vesical calculus	1
Diverticulum of bladder	2
Enlarged prostate	3
Urethral stricture	2
Urethral stricture, diverticulum and stone of bladder	1
Urethral stricture and atony of bladder ..	2
Urethral stricture and enlarged prostate ..	1
Urethral stricture and bilharziasis of bladder ..	1
Cystocele	14
Retention of urine of unknown origin ..	1
Total	30

1. **Fulminating Type.**—Progressive cystitis was seen in its severest form when the pyogenic infection occurred in a bladder which was the subject of an unrelieved acute retention. There were two such cases in this series, and both of them were fatal.

Case 1.—F. E., a male, age 42, was hit on the head by a falling sack. He sustained a fracture-dislocation of the spine, and the spinal cord was completely divided at the level of the third thoracic segment. He developed retention of urine. A catheter was passed once daily on the second, third, and fourth days of the illness, and twice on the fifth day. On the sixth day the urine was blood-stained; a catheter was then tied in, and the bladder was irrigated frequently. The patient died on the eleventh day of the illness.

Post-mortem examination revealed, in addition to the spinal lesions, acute hæmorrhagico-purulent cystitis, ascending pyelonephritis, and septicæmia.

Case 2.—D. J., a female, age 18, had suffered from weakness, drowsiness, and incontinence of urine for a fortnight. Three days before admission to hospital she had become delirious and had had 'convulsive fits'. The bladder was palpable 1 in. above the pubes. She was mentally incoherent and had weakness of the right side of the face, and weakness and loss of reflexes of the lower extremities. A diagnosis of encephalomyelitis was made. The patient gradually passed into a state of deep coma and died.

Post-mortem examination showed that death was due to surgical uræmia following ascending pyelonephritis. A small stone was lying in the base of the bladder. This had evidently been impacted at the neck of the bladder, thereby producing retention of urine, for, at the vesical outlet, the mucosa was necrotic over an area corresponding to the size of the stone. The rest of the bladder was in a condition of severe hæmorrhagico-purulent cystitis.

In both these cases, examples of widely different diseases, the first common factor was retention of urine. The retention preceded and was directly responsible for the onset of the cystitis, and the cystitis was followed, in each instance, by a fatal ascending pyelonephritis.

Fulminating cystitis may supervene in any variety of acute retention, but it is usually seen in cases in which, for various reasons, the retention has developed without giving rise to acute discomfort in the bladder region. It is probably on account of this very absence of pain that the urgency of such retention is apt to be disregarded. In some cases—for example *Case* 9—

distention of the bladder may even be overlooked because there is an associated incontinence of urine.

The transition of a case from a condition of simple retention to one of retention plus fulminating cystitis is extremely insidious. It is only when the kidneys have become secondarily infected that the definite signs appear. The earliest of these are most commonly fever, drowsiness, wasting, pallor, diarrhœa, and pain in one or other loin. By the time these signs have become apparent the condition of the patient is well-nigh hopeless; permanent damage has been done to the kidneys, and death is almost inevitable. Cystoscopy should never be performed in these cases, for the bladder wall is very friable, and the passage of the cystoscope is liable to produce perforation and extravasation of urine.

It is thus clear that little success can be expected in the diagnosis and treatment of fulminating cystitis. But the onset of this condition can be easily and surely prevented if every case of distended bladder, no matter how mild the symptoms which accompany it, is regarded as an emergency. Too much stress cannot be laid on the fact that every distended bladder should be emptied as rapidly as is consistent with safety; and, furthermore, urine should not be allowed to re-accumulate until the normal function of the bladder has been restored. If this cannot be done satisfactorily by indwelling catheter, suprapubic cystotomy should be performed without delay.

2. **Severe Chronic Type.**—The second type of retention cystitis comprised a group of cases in which cystoscopy revealed signs of severe inflammation of the whole of the bladder mucosa. The normal difference between the trigone and the rest of the bladder had disappeared. The surface of the bladder had, for the most part, a homogeneous velvety-red appearance; the outlines of the trabeculæ and the interureteric bar were usually obscured, and the ureteric orifices were represented by mere chinks, not easily found. Submucous hæmorrhages were sometimes seen, particularly around the neck of the bladder. In addition, it was not uncommon to find large sharply defined patches of white membrane, resembling a thin film of sugar icing, spread over the surface of the inflamed mucosa; such areas usually occurred on the base of the bladder. Attached to the surface of the bladder there were often numerous flakes of fibrino-purulent material, which in the more advanced cases appeared, particularly on the fundus, in the form of large white shaggy masses projecting into the lumen of the bladder. These masses were such a striking feature and were so invariably restricted to cases of long-standing retention that we have come to use a special term 'shaggy cystitis' for this type of progressive cystitis. To some extent, 'shaggy cystitis', may resemble extensive ulcerating and necrosing carcinoma of the bladder, a resemblance which was, in the cases of this series, supported by the history of attacks of hæmaturia. In the cystitis cases, however, the masses were more densely white than in carcinoma, and they were entirely avascular. In addition they were much more freely movable; they waved about in the fluid medium; and after repeated bladder irrigations they became detached and nothing beyond an inflammatory change was found in the subjacent bladder wall. The hæmaturia coincided with the detachment of the shaggy masses.

Such appearances indicate a considerable inflammatory hyperæmia and swelling of the mucous membrane, sometimes associated with a fibrinous or fibrino-purulent exudate, which may remain attached to the bladder wall in the form of a membrane or a shaggy mass.

The syndrome produced by this type of cystitis is as follows. The patient, usually a male, states that for years he has had urinary trouble, and that in the last year or so he has been worried by great nocturnal and diurnal frequency. He has frequently been content to put up with this state of affairs until an attack of hæmaturia occurs which impels him to seek treatment. The urine is turbid and contains large flakes of débris; it is alkaline, and smells—so, indeed, does the patient—of ammonia. Residual urine is invariably present; it usually exceeds 5 oz., and the bladder may be palpable in the hypogastrium. It is necessary to spend up to half an hour irrigating the bladder before the medium becomes clear enough for cystoscopy; in fact, a good view of the bladder wall may not be obtained until the bladder has been irrigated on several successive days. The appearances that will then be seen have already been described.

There were eleven examples of severe chronic cystitis in this series. Different cases were preceded by a wide variety of urinary disorders, which had, however, one thing in common, namely, the presence of residual urine in the bladder. It was this retained urine, acting through a long period of time, which had been responsible for the production of the cystitis.

The commonest primary causes of residual urine were urethral stricture, diverticulum of the bladder, disease of the spinal cord, and enlargement of the prostate. The actual etiology of each particular case was, however, usually complicated, as can best be shown by the cases in which the primary affection was a urethral stricture.

Case 3.—**Urethral stricture: diverticula of bladder: vesical calculi: 'shaggy cystitis'.**

F. S., a male, age 56, had had gonorrhœa in 1894. In 1919 he had developed acute retention, due to a calculus impacted behind a stricture of the membranous urethra. Dilatation of the urethra and lithotrity were performed. In 1923 the stricture had become troublesome again, and an internal urethrotomy was done. He was admitted under the care of Mr. Hugh Lett in 1924 complaining of frequent and painful micturition and attacks of hæmaturia.

The urine contained a large amount of pus, and on culture yielded *B. proteus*. X-ray examination showed three vesical calculi, two of which were later found to occupy diverticula; there were also numerous small prostatic calculi. At cystoscopy, in addition to 'shaggy cystitis', there were numerous shallow pouches in the bladder wall and one which was evidently deep. The residual urine measured 2 oz.

At operation, by Mr. Lett, the stones were removed by suprapubic cystotomy and the bladder was drained. Daily irrigation of the bladder was carried out for three weeks, and then the suprapubic wound was allowed to heal. On discharge from hospital his micturition was normal and there was no residual urine; he "felt better than he had done for months".

Case 4.—**Urethral stricture: atony of bladder: 'shaggy cystitis'.**

J. S., a male, age 67, had had gonorrhœa in 1884 and external urethrotomy for urethral stricture six years later. In 1924 he presented himself at the Genito-urinary Department complaining that for one year he had had great frequency of micturition and attacks of hæmaturia.

There was a urethral stricture which required dilatation. When this had been

done, cystoscopy revealed a typical 'shaggy cystitis'. The residual urine on several occasions varied between 30 and 40 oz. There was no sign of prostatic enlargement or of nervous disease, and the large amount of residual urine, even after dilatation of the urethral stricture, could only be attributed to atony resulting from chronic over-distention of the bladder. This view was confirmed by the appearances observed at cystoscopy; when the bladder contained only 10 oz. of fluid its lateral wall and fundus were seen to sag in towards the centre of the viscus—in other words, there was a complete loss of 'shortening reaction' (Sherrington[8]).

The patient was taught to catheterize himself, and the bladder was irrigated once a week. He was greatly improved.

Case 5.—**Urethral stricture: old bilharziasis of bladder: progressive cystitis.**

W. R., a male, age 43, had contracted bilharziasis of the bladder in South Africa in 1901. Two years later he had gonorrhœa. In 1909, after a course of treatment, he was told that he was cured of bilharziasis. In 1913 he began to suffer from occasional hæmaturia and frequency, which increased to such an extent that he had to wear a portable urinal. In 1919 he underwent a course of dilatation for urethral stricture; this relieved but did not cure him, and the frequency was still considerable. Hæmaturia returned in 1921, and he was admitted to hospital under the care of Mr. Lett.

No ova were found, but the urine yielded *B. coli* on cultivation. Cystoscopy showed great swelling and hyperæmia of the whole of the bladder mucosa. The bladder capacity was 'small', and the residual urine measured 3 oz.

The bladder was drained through a suprapubic opening, and washed out daily. After one month the opening was allowed to close, and the patient was discharged from hospital considerably improved.

There were two other cases of severe progressive cystitis and urethral stricture. As in the cases described above, residual urine was present, and was due to a combination of conditions. In one the stricture was associated with atony of the bladder, and the residual urine measured 10 oz. The other, a patient who had 15 oz. of residual urine in the bladder, had had stricture trouble for years, and now had in addition considerable prostatic enlargement. These two cases received great benefit from regular dilatation, catheterization, and bladder irrigations.

Chronic progressive cystitis was also seen in two cases of enlargement of the prostate. In one the residual urine measured 20 oz. Prostatectomy was performed and the cystitis disappeared. The patient was seen again two years after the operation, when his urine was clear and the frequency was normal; in addition he was able to empty his bladder completely and there was no residual urine.

The second case of enlarged prostate demonstrated how, in retention cystitis, pus and bacteria tend to concentrate in the residual portion of the bladder contents, thereby aggravating the cystitis.

Case 6.—**Enlarged prostate: progressive cystitis.**

L. B., age 49, had suffered for eighteen months from frequency and dysuria. One year before he came to the Genito-urinary Department he had been partially relieved by lithotrity, but the frequency had still continued. He had had gonorrhœa fourteen years before.

He passed 8 oz. of slightly turbid urine. A cystoscope (22 Charrière) was then inserted and 8 oz. of residual urine were withdrawn. This urine was quite different in character from the first specimen; it was thick and yellow, and when it had stood for a few minutes a deposit of one-half volume of pus formed. The bladder mucosa showed a severe generalized cystitis and numerous small shaggy

masses on the mucosa of the neck. The lateral lobes of the prostate were seen to be greatly enlarged.

A similar observation may sometimes be made at the operation of suprapubic cystotomy for retention of urine and enlarged prostate when cystitis is also present. The urine which escapes when the bladder is opened is almost or quite clear, whereas that which comes later from the bottom of the bladder contains a large amount of pus. It is therefore evident that stagnation of pus and bacteria occurs in bladders which cannot empty themselves completely. Even when, as in *Case* 6, the bladder is capable of expelling half its contents, the forcible contractions of the bladder detrusor which are necessary to such an act do not bring about admixture of the contents. The same urine may remain in the bladder for days at a time although the patient is passing water with comparative freedom. This residual urine becomes loaded with pus, and is in effect a focus from which further infection of the bladder is continually occurring. Bladder irrigations are of the greatest benefit in retention cystitis, and the manner in which they act is readily understood in the light of the observations made in *Case* 6. By washing out the bladder until the fluid is returned clear the infective residual urine is removed.

There were two cases of diverticulum of the bladder in which advanced cystitis was present. The diverticula in both cases opened in the base of the bladder immediately behind the ureteric orifice. The situation of the diverticula appeared to be a point of some importance, for, during the period under consideration, several other cases of bladder diverticulum were observed in which there was practically no cystitis at all, and in these cases the diverticulum was always situated at the fundus of the bladder. That is to say, when a diverticulum opens in a dependent part of the bladder, stagnation of urine occurs within it and cystitis is accordingly produced; whereas in the case of a fundal diverticulum there is no stagnation of urine and, consequently, no cystitis. If man stood on his head instead of on his feet the basal diverticula would then be the innocuous ones. Possibly postural treatment may be of value in cases of basal diverticula in which operation for some reason cannot be carried out; but I have had no experience of this form of treatment, nor have I found any reference to it in the literature.

One of the diverticulum cases illustrated another retention factor which may act in progressive cystitis: severe cystitis itself, it appears, can aggravate a pre-existing retention.

Case 7.—**Persistent suprapubic fistula after suprapubic lithotomy: diverticulum of bladder: chronic progressive cystitis.**

F. S., age 27, was admitted under the care of Mr. Lett, on account of a persistent suprapubic fistula which had followed the removal of a vesical calculus elsewhere six months before. One attempt had already been made to close the fistula by operation, without success.

He was treated by indwelling catheter and daily bladder irrigations for six weeks, at the end of which period the suprapubic wound had closed. Cystoscopy then showed severe general cystitis and, behind the mouth of the right ureter, the orifice of a diverticulum. The bladder irrigations were continued, but the catheter was now removed and the patient was encouraged to make water. He tried very hard, but seemed quite unable to do so, and the suprapubic fistula re-opened. After another period of treatment by indwelling catheter the fistula healed, but when he

tried to pass water naturally he was again unable to do so and the urine came through the wound. Accordingly another operation was performed, at which the diverticulum was removed; this involved resection of the lower part of the right ureter, the upper cut end being transplanted into the adjacent bladder wall. The patient died six days later of ascending pyelonephritis. At necropsy the spinal cord was found to be normal.

In this case there was no mechanical obstruction to the outflow of urine, and the nervous paths were normal. The acute retention must therefore have been due to some disturbance of the bladder musculature, probably spasm of the sphincter, which was brought on by the pre-existing cystitis. *Case* 8 in its later stages also showed that cystitis by itself may produce retention. Similar observations have been made by Head and Riddoch[3] in cases of spinal injury: They state that "long-continued cystitis tends . . . at any rate in the early stages, to decrease the completeness with which it [the bladder] is evacuated". Thus it appears that a vicious circle may be established; residual urine is responsible for the production of cystitis, which may in turn produce further retention of urine, and this aggravates the cystitis. The only way in which such a circle can be broken is by complete drainage of the bladder.

There was one example of progressive cystitis associated with spinal-cord disease. This case was of great interest because it remained something of a mystery until our study had advanced so far as to reveal to us the true value of the retention factor in the production of cystitis. The case as it presented itself to us was as follows:—

Case 8.—**Old tuberculous disease of the spine: atony of bladder: progressive cystitis.**

T. G., age 64, complained of frequent, difficult, and painful micturition. He had had this trouble for an indefinite number of years, but it had been getting much worse in the last two months. As a young man he had had gonorrhœa, and ten years before he came to the Genito-urinary Department he had had spinal caries; as a result he had lost 4½ in. in height, and had now an extensive kyphosis in the dorso-lumbar region.

The cystoscope (22 Charrière) was passed without any difficulty. There was general hyperæmia and swelling of the bladder mucosa and a very slight intravesical enlargement of the lateral lobes of the prostate. The residual urine measured 3 oz. and the bladder capacity only 5 oz.

Here was a case of cystitis which was manifestly not associated with enlarged prostate or urethral stricture. When it was realized that the residual urine was the key to the situation a further search was made for some pre-existing cause of retention. None of the usual signs of nervous disease was present, but a closer inquiry revealed that he had had paraplegia when he was ill with spinal caries, and that the symptoms of cystitis had come on after that. The case was now clearly understood. At the time of the spinal caries some permanent damage had been done to the nervous paths for micturition in the lumbo-sacral portion of the spinal cord. The reflexes governing the act of micturition were thenceforward impaired, and chronic retention of urine ensued and was responsible for the onset of cystitis. The case also showed that cystitis acting through a long period of time may cause great reduction of the bladder capacity.

There was one case of severe progressive cystitis in which the retention factor was of somewhat obscure origin.

Case 9.—**Retention of urine (? cause): progressive cystitis.**

E. P., age 20, came to the London Hospital on account of incontinence of urine. The bladder was distended, the fundus being palpable 1 in. below the umbilicus, yet he was wearing, and had for the past fortnight worn, a portable urinal! He was admitted at once.

Three months before, he had had an obscure febrile illness which was at first thought to be typhoid fever; this diagnosis proved to be incorrect, for his serum never agglutinated either *B. typhosus* or *paratyphosus A* or *B*, and the febrile symptoms cleared up within ten days. Towards the end of this illness retention of urine developed. The retention was relieved once or twice daily by catheter, and at the end of a week he passed water again, small amounts at frequent intervals. At this time the urine contained a little blood and a lot of 'matter'. In the absence of any other demonstrable cause of retention, the prepuce, which was phimotic, was removed. The operation did not cure his trouble; frequency and hæmaturia continued and, later, incontinence of urine developed. In addition he began to have unquenchable thirst and a constant aching pain in the hypogastrium. He then came to the London Hospital, and was admitted under the care of Mr. Lett.

The urine was alkaline, contained blood and pus, and yielded *B. proteus* on cultivation. Examination of the urinary tract for calculi was negative. No abnormality of the nervous system was detected.

A catheter was tied in; the bladder was slowly emptied, and thereafter irrigated twice daily with a 1–4000 solution of oxycyanide of mercury. Some trouble from blockage of the catheter occurred at the beginning of this treatment, and his condition became very critical. He began to have pain in the right loin, uncontrollable diarrhœa, and occasional vomiting. The temperature rose to 102°, the tongue was dry and coated, and his features took on a sunken, pinched appearance. In addition he became drowsy, languid, and increasingly pale. It was clear that he was developing ascending pyelonephritis.

Prompt attention to the catheter and increase in the number of daily bladder irrigations averted a catastrophe, and in a short time the patient began to improve. Cystoscopy a fortnight after he was admitted to hospital showed extremely severe hyperæmia and swelling of the bladder mucosa, numerous large white shaggy masses, and a few submucous hæmorrhages.

He was treated for a further three weeks by indwelling catheter and bladder irrigations, at the end of which time the bladder inflammation was seen by cystoscopy to be recovering. The catheter was then removed, but was passed once daily for bladder irrigation until there was no longer any residual urine. When discharged from hospital two months after admission his urinary functions were normal and he was free from symptoms.

There was no abnormality of the prostate, urethra, or nervous system in this case, and it was evident that the retention must have arisen as a result of the febrile illness or the phimosis. The retention preceded and caused the cystitis, and a vicious circle was then established; for, after the original cause or causes of retention had been removed, the bladder remained in a condition of acute retention, a condition which can only have been due to the cystitis. If complete drainage of the bladder had not been promptly established and maintained, the patient would have died of ascending pyelonephritis.

It will be convenient to review briefly the cases of severe progressive cystitis which have been described above.

A number of different pathological conditions gave rise to cystitis. In

each case the cystitis was preceded by a partial retention of urine which was an expression of the derangement of bladder function produced by pre-existing disease.

When the cause of the retention could be removed, the recovery from cystitis was complete.

When, in the cases in which the function of the bladder had been irreparably damaged, complete drainage of the bladder was established, the cystitis tended to clear up at once; the completeness of the cure in these cases was only limited by our inability to remove the cause of the retention and our disinclination to establish permanent suprapubic drainage.

Catheterization and irrigation of the bladder were of great value in these cases; by such measures the bladder was temporarily emptied and washed free of all retained urine.

There is, therefore, a volume of evidence to show that retention of urine is an extremely important cause of chronicity in cystitis. It is clear that cystitis must not be treated empirically. When residual urine is present in cases of cystitis its cause must be sought and removed if the cystitis is to be cured. If the retention of urine is neglected or overlooked, the cystitis may increase in severity and a fatal ascending infection of the kidneys may develop.

3. **Mild Chronic Type.**—In this group have been included cases of persistent cystitis in which the inflammatory changes were almost or entirely confined to the base of the bladder. The usual appearance at cystoscopy was a redness and swelling of the mucosa of the trigone. On this inflamed surface confluent groups of small cysts (cystitis cystica) or papules (granular cystitis), and sharply defined patches of 'sugar icing' were frequently seen. Submucous hæmorrhages occurred occasionally. The symptoms associated with these lesions were frequency, dysuria, and occasionally hæmaturia—of a much milder degree than occurred in severe progressive cystitis. The general health was not seriously lowered, and it was possible to treat practically all of the cases in the Cystoscopy Department.

There were 16 cases of mild progressive cystitis. In all of them there was present some lesion of the urinary tract which prevented the bladder from emptying itself completely at each act of micturition. Urethral stricture was found in one case, enlarged prostate in another, and in the remaining 14 cases a cystocele, usually of minor degree. Residual urine was present in amounts varying from 1 to 3 oz.

When the retention factor could be completely removed, as in the case of enlarged prostate and stricture, the cystitis disappeared. In the cases of cystocele, treatment by a suitable ring pessary was followed by subsidence of the cystitis.

Two practical difficulties arose, however, in the treatment of the cystocele cases. Apparently treatment of the small cystocele by ring pessary is not invariably satisfactory. The ring pessary, it seems, will not control those cystoceles which are unaccompanied by prolapse of the uterus. It is difficult to keep clean, and, if not changed regularly, may produce vaginal hæmorrhage. Thus, in the case of a woman, 67 years of age, a mild progressive cystitis was immediately relieved by the insertion of a ring pessary. When she had worn

it for six months she began to bleed from the vagina, and the pessary was accordingly removed. Two months later she had another attack of cystitis. Thus our first difficulty was that in some cases the logical treatment—namely, the elimination of the retention factor—could not be carried out.

The second difficulty in treatment arose from the fact that often the symptoms were not confined to the urinary system. Some patients exhibited nervous and abdominal symptoms, such as headache, nervousness, mental breakdown, epigastric or general abdominal pain, 'falling of the abdomen' on standing up, and, almost always, a feeling of general weakness. These patients were, in fact, examples of that condition which is at present termed 'visceroptosis'. They differed from the usual type of 'visceroptosis' in that, having developed mild cystitis, their principal symptoms were pelvic rather than epigastric. Pessary treatment was often contra-indicated in these cases.

It will thus be seen that the cure of cystitis with cystocele may be a difficult matter. In this series great improvement sometimes followed the injection of collargol (10 to 20 per cent) into the bladder. Where 'visceroptosis' was present the provision of an abdominal belt seemed to help in alleviating not only the abdominal but also the urinary symptoms. A potassium bromide mixture was also useful in these cases. When the ring pessary could be worn, cure followed. In the other cases complete cure was difficult to obtain and relapses were common.

Before considering the second great factor in the production of progressive cystitis, it is necessary to point out that by no means all cases in which the bladder contains residual urine develop cystitis. Similarly, cases of cystitis, in which there is residual urine, albeit a small amount, may recover without any treatment having been directed against the retention factor. There is, however, no doubt that in all cases of cystitis cure will be most quickly obtained by direct treatment of the retention factor; and, except for the cases which are now to be considered, only those will become chronic in which the bladder contains residual urine.

PROGRESSIVE CYSTITIS DUE TO PERSISTENT KIDNEY INFECTION.

Of the 55 traced cases of progressive cystitis, 24 were due to infection of the kidney pelvis. The relationship between the kidney lesion and the cystitis was most distinctly shown in cases of pyonephrosis. There were 5 such cases, of which the following is an example.

Case 10.—**Pyonephrosis: severe cystitis: nephrectomy.**

M. T., female, age 23, under the care of Mr. H. S. Souttar, had suffered for three weeks from severe pain in the left loin, vomiting, and frequency of micturition.

She looked very ill and her temperature was 102·4°. There was great tenderness and rigidity over the left kidney region. The urine contained a large amount of pus (culture, *B. coli*). She was treated with large quantities of fluids and large doses of alkalis, but she grew steadily worse. Cystoscopy showed a severe cystitis; the whole of the bladder mucosa was intensely hyperæmic and œdematous. A continuous stream of thick pus was seen to pour from the left ureteric orifice.

The left kidney was explored. A huge pyonephrosis was found, and the kidney was accordingly removed. The post-operative course was uneventful. Three weeks after the operation the urine was normal except for a trace of albumin and pus. At cystoscopy slight cystitis of the trigone was found, but the remainder of the bladder mucosa had become normal.

The patient was seen again one year after the operation. She had had no urinary symptoms since discharge from hospital and her urine was normal. It must be presumed, therefore, that the recovery was as complete as it was rapid.

This case shows that severe cystitis may be produced by infection from the kidney. It shows, too, how quickly a bladder will recover when once the infective focus is removed.

In the 19 cases of progressive cystitis associated with pyelitis the relationship between kidney and bladder lesions could not be so distinctly proved, for the obvious reason that the kidney focus could not be controlled, as it was by nephrectomy in cases of pyonephrosis. In many cases, however, there was clinical evidence of a pre-existing (and primary) kidney pelvis infection. The illness had been ushered in with pain in one or other loin, associated with high temperature and shivering. In a few cases there were no symptoms of primary pyelitis. In one of these, examination by X rays, which is performed as a routine, showed a stone in the right kidney, and led to the detection of the primary cause of infection.

Evidence obtained by cystoscopy was of very great value. The presence and persistence of signs of inflammation around one ureteric orifice was an indication of infection of the corresponding kidney pelvis. In the following remarkable case this cystoscopic sign gave the only clue to the origin of the cystitis, and it did not appear until the case had been under observation for three months.

Case 11.—**Progressive cystitis: 'concealed' pyelitis.**

A. S., female, age 22, attending the Genito-urinary Department, had had for seven months attacks of painful, urgent, and frequent micturition, associated with hæmaturia. The attacks lasted a fortnight, and came on about once every six weeks. The pain occurred during micturition, in the hypogastrium and at the urethral orifice. There had been no pain in the loins. The urine contained pus and blood. Cystoscopy showed moderate general cystitis, and an area of ulceration between the ureteric orifices.

The patient was treated for three months with injections of collargol (20 per cent) into the bladder. The pain and frequency decreased but did not disappear, and the urine still contained pus and occasionally blood. At cystoscopy it was now seen that there was a patch of ulceration and injection in the neighbourhood of the right ureteric orifice, whereas the rest of the bladder showed little abnormality. Collargol was accordingly injected through a ureteric catheter into the right kidney pelvis. Within a fortnight the symptoms had entirely disappeared and the urine had become clear.

Injection of collargol into the pelvis of the kidney was followed, in this case, by immediate disappearance of the cystitis. The same treatment was similarly effective in other cases of progressive pyelocystitis in which the primary pyelitis was not complicated by pregnancy, stone, or hydronephrosis. In a few cases in which there was definite clinical evidence that pyelitis had preceded cystitis, injection of collargol merely into the bladder was followed by cure. This may have been due to regurgitation of the collargol up the ureters, for Volker[9] has shown that in some cases collargol injected into the bladder can be detected in the pelvis of the kidney a short time afterwards.

From consideration of the evidence given above it is clear that chronicity may be due to a persistent infection from the kidney.

SOLITARY ULCER OF THE BLADDER.

In an early part of this paper it was stated that of the 55 cases of progressive cystitis there was one the chronicity of which could not be explained by the presence of either a retention factor or a persistent infection from the kidney. This was a case of solitary ulcer of the bladder. The case is a good example of an uncommon type of cystitis the pathogenesis of which is still uncertain.

Case 12.—**Progessive cystitis: solitary ulcer of bladder.**

L. S., a Polish Jew, age 35, came to the London Hospital in 1915 complaining that for one year he had had painful and frequent micturition with occasional hæmaturia. At the onset of the illness he had had a urethral discharge for eight days, but this had not recurred. The urine contained pus. At cystoscopy the left lobe of the prostate was seen to be enlarged. The left seminal vesicle also was found by rectal examination to be enlarged. X-ray examination of the urinary tract was negative. A diagnosis of prostatitis and vesiculitis was made. The patient failed to attend for treatment.

He reported again in 1917 with the same symptoms. He was treated for three months by irrigations of the posterior urethra. His symptoms were eased, so he went away before completing his course of treatment.

Since Jan., 1922, he has been attending the Genito-urinary Department occasionally, and at the time of writing (Jan., 1925) he is still under treatment. He suffers from frequency (twice during the night and half-hourly by day), and he has pain in the hypogastrium at the end of micturition. About once every six months he has had an attack of hæmaturia, which is accompanied by increase of frequency and pain. He has never had pain in the kidney regions. General examination reveals nothing abnormal. The Wassermann reaction is negative.

The urine contains small threads, pus, and red blood-corpuscles; cultures are sterile, and examination for tubercle bacilli has been negative on several occasions. There is no residual urine. The bladder capacity is limited to 5 oz.; over-distention of the bladder causes acute discomfort and hæmaturia. The blood comes from an ulcer, about 1 cm. diameter, some distance above the right ureteric orifice. The ulcer has a red base and sharply-cut edges; the surrounding mucosa is perfectly healthy. The prostate is slightly enlarged, and the adjacent bladder mucosa shows slight œdema and injection. The rest of the bladder mucosa and the orifices of the ureters are normal.

This ulcer was observed by cystoscopy three years ago and has been examined many times since then. It has not increased in size, but on the other hand it has never healed in spite of various forms of treatment. The symptoms are considerably relieved by injection of collargol (20 per cent) into the bladder, and the patient is always anxious to have this form of treatment.

SUMMARY.

1. From the foregoing account it is evident that cases of cystitis fall into two main groups: (*a*) Those which clear up quickly, either spontaneously or after simple forms of treatment (*resolving cystitis*); and (*b*) Those which become chronic (*progressive cystitis*).

2. The paths of bacterial infection in resolving cystitis are not completely understood. In some cases the infection undoubtedly comes from the kidney, in others possibly from the prostate. There remain, however, many cases in which it is impossible to determine the source of the infection.

3. Chronicity in cystitis is due to a number of conditions. In rare cases it is due to a solitary ulcer of the bladder, a condition of unknown etiology.

In most cases it is due either to persistent infection from the kidney or to the presence of retained (or residual) urine in the bladder.

4. A persistent focus of infection in the renal pelvis may give no clinical signs. Evidence obtained by cystoscopy is frequently of great value in the detection of such foci. If the lesion of the renal pelvis is treated efficiently, the cystitis will clear up at once.

5. Any variety of retention of urine may produce progressive cystitis. The successful treatment of retention cystitis depends entirely on the establishment of complete drainage of the bladder either by natural or artificial means. Bladder irrigations are of great service in this variety of cystitis.

6. When cystitis occurs in a case of unrelieved acute retention there is grave danger that it will be followed by ascending pyelonephritis, a condition which is usually fatal. When it is realized that all cases of retention of urine require immediate and complete relief, then only will ascending pyelonephritis, the occurrence of which is a grave reflection on the teachings and practice of surgeons of to-day, cease to be common. Drainage of the distended bladder is an operation of greater emergency than that of drainage of a pelvic abscess.

7. Finally, cystitis, though a distinct clinical entity, is usually secondary to some other lesion of the urinary tract. It should not be treated empirically; the exciting and predisposing causes should be sought by a thorough investigation of the whole of the urinary tract. When these causes have been dealt with, the inflammation of the bladder will subside of its own accord.

I desire to thank the surgeons of the London Hospital for permission to study their cases, and further to express my indebtedness to Mr. Hugh Lett, Director of the Genito-urinary Department, and Mr. G. E. Neligan, for their inspiration and advice during the preparation of this paper.

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RIEDEL'S CHRONIC THYROIDITIS: WITH A REPORT OF SIX CASES AND A CONTRIBUTION TO THE PATHOLOGY.

By A. F. BERNARD SHAW and R. P. SMITH, Newcastle-upon-Tyne.

A peculiar affection of the thyroid which is of special interest to the surgeon and the pathologist was first described in 1896 by Riedel as a " chronic inflammation of the gland leading to the formation of an iron-hard tumour ".

The disease occurs both in men and women, and is characterized by the appearance in the thyroid of an extremely hard tumour. Frequently the whole gland is enlarged, but one lobe only may be attacked. Sometimes a localized nodule is present without general enlargement. The date of onset and mode of development may be difficult to elicit; the swelling may begin on one side and then extend to the rest of the gland, but in some cases it appears to begin diffusely. It may first be noticed by the relatives. The rate of growth is often slow at first, but later becomes accelerated. In a few cases there is a history of fluctuations in size. The swelling seldom forms a bulky tumour, and its comparatively small size compared with the marked symptoms has often been emphasized. Pain is rare. The early cases are without symptoms, but there is a remarkable tendency for the tumour to become adherent to and even to infiltrate the neighbouring structures; it becomes firmly fixed to the trachea, carotid vessels, recurrent nerves, and other structures. The skin, however, is rarely involved. Pressure symptoms cause the patient to seek relief. The symptoms are increasing dyspnœa with suffocative attacks, particularly at night, dysphonia or aphonia, and sometimes dysphagia. The general health is fairly good, and the medical history without special moment. There is no clinical evidence of hypo- or hyperthyroidism.

The most striking feature of the tumour is its remarkable hardness and density, which has been likened by various observers to iron, stone, wood, cartilage, or bone. Usually it is smooth or only finely nodular on the surface. With extensive adhesions the cervical structures are obscured, the margins of the tumour ill-defined, and there is loss of mobility. The lymph-nodes are not enlarged. There is no pyrexia, and a general clinical examination reveals no special abnormality. The clinical picture bears a close resemblance to certain forms of cancer, and most of the cases hitherto described have been diagnosed at first as malignant disease. The cut section of the gland is hard, smooth, creamy-white, opaque, and often intersected by fibrous strands. Microscopically there is no evidence of malignancy.

The only successful treatment, at present, is surgical. Drugs and X rays have proved of no value. Cure has been effected by complete thyroidectomy. Resection of a small portion of the tumour has been followed by resolution

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The most striking feature of the tumour is its remarkable hardness and density, which has been likened by various observers to iron, stone, wood, cartilage, or bone. Usually it is smooth or only finely nodular on the surface. With extensive adhesions the cervical structures are obscured, the margins of the tumour ill-defined, and there is loss of mobility. The lymph-nodes are not enlarged. There is no pyrexia, and a general clinical examination reveals no special abnormality. The clinical picture bears a close resemblance to certain forms of cancer, and most of the cases hitherto described have been diagnosed at first as malignant disease. The cut section of the gland is hard, smooth, creamy-white, opaque, and often intersected by fibrous strands. Microscopically there is no evidence of malignancy.

The only successful treatment, at present, is surgical. Drugs and X rays have proved of no value. Cure has been effected by complete thyroidectomy. Resection of a small portion of the tumour has been followed by resolution

of the remaining portion in a number of cases. Spontaneous retrogression has been reported. When the disease is limited to the gland, removal presents no difficulty; but in cases with extensive extra-thyroidal lesions, operation is difficult and dangerous, and success depends largely on the judgement of the operator in deciding the moment at which to stop before damage is done to the cervical structures. Fatal accidents have occurred when removal has been attempted in the face of severe adhesions. Tracheotomy is not advisable unless the dyspnœa is extremely urgent. If complete extirpation is impossible, partial removal offers the best prospects. The inoperable cases die of suffocation.

The affection passes under various names which express more or less the importance of some clinical or pathological character, viz., 'primary chronic canceriform inflammation' (Tailhefer); 'primary chronic inflammation' (Berry), 'ligneous thyroiditis' of French writers, 'fibrous degeneration' (Ricard), 'struma lymphomatosa' (Hashimoto), 'benign granuloma' (Ewing), and 'chronic productive thyroiditis' (St. George).

The disease seems to have attracted little attention in this country, owing, no doubt, to its rarity. Berry gives a concise account from the clinical side (including 3 cases) in his *Diseases of the Thyroid Gland*, and the pathology is succinctly described in Ewing's *Neoplastic Diseases*. Apart from these there is no comprehensive description, and in the current text-books the disease is mentioned very briefly. We have collected only 23 cases from the literature since 1896, and these we have arranged in tabular form so as to illustrate points of interest in diagnosis, treatment, course, and sequelæ.

In the last few years we have seen 6 cases, the study of which presents several interesting features both clinical and pathological. They form a series illustrating successive phases in the clinical and pathological evolution, and show that the original conception of Riedel's disease must be extended to include the condition described by Hashimoto in 1912 as 'struma lymphomatosa', this being really the early stage of the affection. The histological changes are inadequately described in the literature and not generally recognized. In several cases the condition has been mistaken for malignant disease. We have therefore described the histology in detail. In addition, one of our cases suffered from Addison's disease, and the adrenals showed changes analogous to those in the thyroid. This, we believe, is the first time the association has been recorded.

PARTICULARS OF CASES.

Case 1.—Female, age 36. Admitted to hospital with typical Addison's disease of one year's duration. No history of thyroid disturbance or of enlargement of the gland. She died two months after admission.

SECTION.—The thyroid, which had caused no symptoms during life, was moderately and uniformly enlarged and hard. The cut surface was white, opaque, solid-looking, and devoid of colloid. The capsule was not appreciably thickened, and there were no adhesions. Larynx and trachea normal. Both adrenals showed extreme fibrous atrophy, their maximum thickness being 3 mm. The thymus weighed 16 grm., but there was no general lymphatism. The pituitary, pineal, and pancreas showed no special change histologically. There was no evidence of tubercle in any of the organs.

HISTOLOGY.—

1. *Thyroid.*—Sections from several parts of the gland show the same changes. The capsule is slightly thickened by mature fibrous tissue in which are scattered foci of round cells and islets of atrophied epithelium. The external surface is ill-defined and evidently invading the surrounding adipose tissue. The capsular vessels are normal. The interlobular septa are thickened, but there is no diffuse fibrosis. The most striking feature is the intense round-cell infiltration, which has overrun the gland, replacing the acini in many areas and forming numerous lymph-follicles with large germ centres (*Fig.* 51). The majority of the cells are lymphocytes, but there are numerous plasma cells and some larger phagocytic cells. The whole are lodged in a delicate reticulum of collagen fibrils and young fibroblasts. There are very few capillary blood-vessels. The lymph-follicles are round and variable in size; the germ-centre, usually about four-fifths the diameter of the follicle, is bounded by a narrow zone of lymphoid cells. Reticulum fibres seem to be absent in the germ-centre, which is mainly composed of large pale reticular cells, loosely arranged and

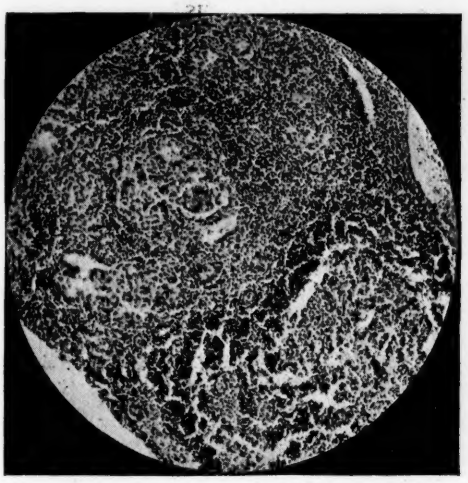

FIG. 51.—*Case* 1. Thyroid showing early stage with diffuse cellularity. Surviving gland tissue is hypertrophic. No fibrosis. Sector of a lymph-follicle to one side.

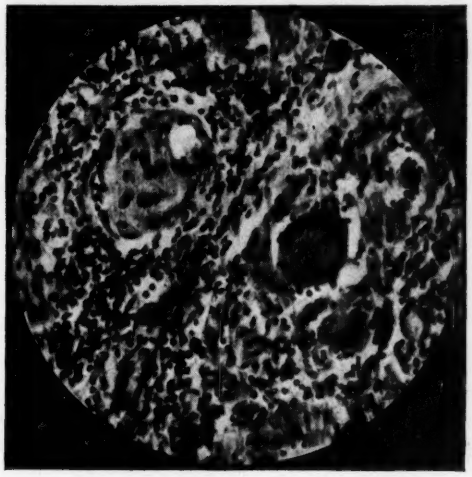

FIG. 52.—*Case* 1. Thyroid showing diffuse cellularity, solid hypertrophic acini, and two giant cells.

easily washed out of the preparation. These cells are actively phagocytic to the remains of thyroid epithelium and droplets of colloid which are scattered about, and often show mitosis. Everywhere the acini are altered and reduced in number. Occasionally where there is little cellularity the vesicular structure is retained, the epithelium is normal, and colloid is present; but for the most part the colloid has disappeared and the acini are solid. The epithelial cells are much enlarged, the nucleus is prominent and sometimes lobulated, the protoplasm vesiculated (*Fig.* 52). A few cells show mitosis. Sometimes a small lumen is present containing a watery material or, perhaps, a droplet of thick colloid. The appearances clearly indicate increased functional activity. At the same time there is evidence of degeneration in many of the cells: pyknosis, crenation, chromatolysis of the nucleus, and invasion of the cell-body by phagocytes from the surrounding round-cell infiltration. Where the acinus still contains a lumen, the epithelial cells become detached and break down. Frequently a mass of these cells fuse together—often round a drop of colloid as a nucleus—to form a giant cell, which is then invaded by phagocytes and ultimately destroyed (*Fig.* 52). Some of these formations, especially when they present a homogeneous centre of colloid with a peripheral ring of nuclei, closely resemble tubercle giant cells. There is, however, no doubt that they are epithelial in origin.

2. *Adrenals.*—The changes are the same in both organs. Parenchymatous tissue is present only in the central portion of the gland ; it is so altered by degenerative change that it is difficult to be sure of its nature, but it appears to be cortical tissue. The cells lie in small groups, isolated by a delicate vascular connective tissue infiltrated with round cells, these being lymphocytes, plasma cells, and some phagocytes. There are a few small lymph-follicles with germ-centres, but these are much less developed than in the thyroid. At the peripheral parts of the gland all trace of adrenal tissue has disappeared, so that at one pole the stroma which contains some foci of round cells has collapsed, allowing the capsule of the opposite sides to come together. At the other pole the stroma is densely infiltrated with round cells, among which is the débris of adrenal tissue (*Fig.* 53). The capsule of the gland is thickened by a hyaline fibrosis. There is no evidence of tubercle.

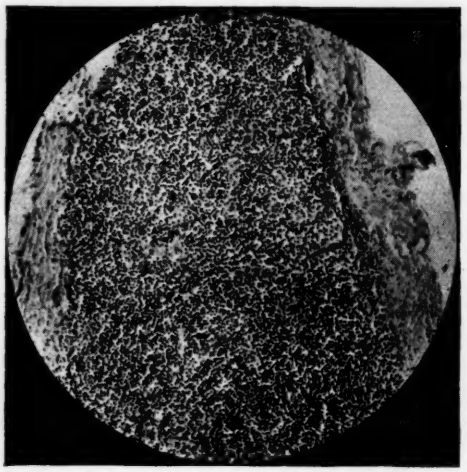

FIG. 53.—*Case* 1. Adrenal showing similarity of the change to that in the thyroid.

Case 2.—Female, age 32, under the care of Mr. G. Grey Turner.

ON ADMISSION.—There is a small painless tumour in the neck which had been present for six months and was getting larger. She had recently suffered from a severe and prolonged furunculosis treated by vaccines, but apart from this there was nothing of note in her history. There is an extremely hard painless nodule in the right lobe. The thyroid itself is not enlarged, and the nodule caused no symptoms. There are no signs of functional disturbance. As the nodule was growing and the patient of nervous temperament, it was decided to remove it. The nodule was fixed and difficult to enucleate ; there was no excessive bleeding.

SECTION.—The nodule was very hard, opaque, and white, and described as 'anæmic fibrosed thyroid tissue'. No clinical opinion was expressed as to its nature. Normal recovery.

She has been seen periodically, and at the present time (two and a half years after operation) is in good health and without recurrence.

HISTOLOGY.—The structure is similar to that of the thyroid in *Case* 1, the only differences being that the capsule of the nodule and the interlobular septa are thicker from fibrosis, normal acini are more numerous, and there is less evidence of hypertrophy of the gland cells.

Case 3.—Female, age 55, under the care of Mr. R. J. Willan.

ON ADMISSION.—There was a painless swelling on the right of the neck ; first noticed one year ago, when it was the size of a pigeon's egg. She suffers from attacks of nocturnal palpitation, dyspnœa on exertion, and slight dysphagia ; no dysphonia. She says she has not lost weight. Her previous history is without note, and she has never had goitre before this. She is a spare woman, without any signs of functional disturbance of the thyroid. The right lobe of the gland forms a bulky, very firm tumour, not fixed to the skin or deeper structures. The lymph-nodes are not enlarged. The rest of the thyroid appears normal. The tumour was thought to be a hard adenomatous goitre.

OPERATION.—Right hemithyroidectomy on the day after admission. The tumour came away easily and with little bleeding. There was some pressure on the trachea. The mass weighed 150 grm. ; it was firm, solid, creamy-white, smooth on surface, without fibrosis or thickening of the capsule. It was thought to be sarcoma.

Uneventful recovery. She is now in good health and without recurrence twelve months after operation.

HISTOLOGY.—Sections from different parts show the same changes. The appearances, however, are not the same as in the previous cases. There has been great destruction of the acini. The lobular structure of the gland is gone, the whole tissue being invaded by a profuse infiltration of cells which at first suggest a sarcomatous growth. The cellular infiltration is composed of lymphoid cells, plasma cells, and phagocytes lodged in delicate fibrous reticulum, but differs from the other cases in the presence of a great number of cells which appear to be young active fibroblasts. These cells are large, pale and plump, irregularly shaped, and with fine processes. The nucleus is large and vesicular, round, oval, or lobulated. Mitoses are common. There appear to be transitions between these cells and phagocytes. Capillaries and other vessels are scanty. Lymph-follicles are absent. Although fibroblasts are so abundant, the only evidence of fibrosis is the fine diffuse reticulation. Neither the capsule nor the fibrous septa are thickened. The capsular vessels are normal. The surviving acini appear either as colloid-containing vesicles or as solid structures showing both hyperplastic and degenerative changes. There are no giant cells, owing probably to the great destruction of parenchyma. A large amount of disorganized epithelium is strewn about, and this, with the marked activity of the fibroblasts without appreciable fibrosis, indicates recent and severe glandular demolition with early repair. Attached to the exterior of the capsule is some adipose tissue in which are foci of round cells, evidence of early extracapsular extension.

Fig. 54.—*Case* 4. Present state. Enlarged left lobe and isthmus. Right lobe removed two and a half years previously.

Case 4.—Female, age 47, under the care of Dr. Pearson whom she first consulted, nine months prior to admission, for shortness of breath on exertion. He found a uniform, firm, painless enlargement of the thyroid. Three months later the right lobe had become larger and harder. During the next six months the dyspnœa increased, dysphagia, hoarseness, and attacks of aphonia developed, and for these she was admitted under Mr. Collingwood Stewart for operation. The majority of the right lobe was removed. It came away easily and with little bleeding. No fixation to surrounding tissue. It was thought to be malignant, and was not examined histologically. The wound healed per primam, and symptoms were relieved.

Two years later she returned with severe dyspnœa and the history that two months after operation a swelling appeared in front of the neck. A small very hard tumour was found in the isthmus. This was removed with difficulty owing to adhesions. The specimen as received by us measured 5·0 cm. by 3·0 cm., and showed the gross and histological changes of Riedel's struma. The wound healed normally, and dyspnœa was relieved.

She returned three months later, when she was first seen by us, because of swelling of the left lobe with dyspnœa on exertion, dysphagia, and hoarseness. She is a spare pale woman showing no signs of hypo- or hyperthyroidism. There is a history of rheumatic fever in childhood, and there are old scars of tuberculous glands in neck. No goitre in family. The left lobe is enlarged (9·0 cm. by 4·0 cm.), smooth, painless, and feels like cartilage (*Fig.* 54). The upper margin extends nearly to angle of jaw,

the lower pole is just behind sternoclavicular joint. The tumour moves on deglutition, but is firmly fixed to the trachea ; the posterior edge is ill-defined. The overlying skin is not adherent ; the lymph-nodes are not palpable. The remains of the isthmus are slightly enlarged and extremely hard. No signs of recurrence on right side. The trachea is pushed to the right. Laryngoscopy (Mr. Frank Wilson) shows left recurrent paresis, fixation of left cord, over-abduction of right cord, reduction of rima to half its normal size, but no evidence of recent or old inflammation. X rays shows no tracheal stenosis, and the mediastinum appears normal. Blood examination : some secondary anæmia. Wassermann, negative (before and after a provocative dose). During the last three months she has been seen periodically. The swelling is slowly increasing, dyspnœa is more marked, and she is having nocturnal attacks. Recently she has had a course of N.A.B., as it was thought that this might prove beneficial and so avoid removal of the tumour. It has had no effect.

HISTOLOGY.—Portion removed at second operation. This is similar to *Cases* 1 and 2, but in a more advanced stage. The capsule is much thickened by hyaline fibrosis ; it contains foci of round cells and atrophied acini, but no extracapsular

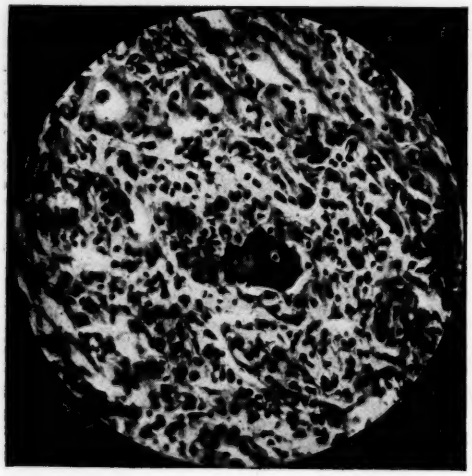

FIG. 55.—*Case* 4. Thyroid. Area of demolition showing early fibrosis. Giant cell degenerating.

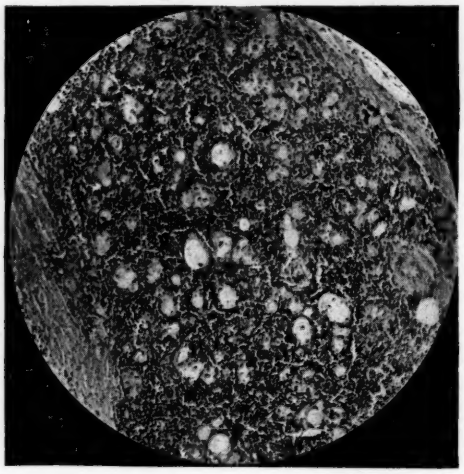

FIG. 56.—*Case* 4. Thyroid showing hyaline fibrosis at periphery of field.

structures. The capsular arteries are thickened. Running throughout the gland are broad interlacing bands of hyaline fibrous tissue in which are incarcerated remains of acini, foci of round cells, and atrophied lymph-follicles. At the edges of these bands the earlier stages of fibrosis can be seen, where active fibroblasts and collagen fibrils are being laid down among the disintegrated acini (*Fig.* 55). The round-cell infiltration is not so marked, as it is being replaced by fibrous tissue (*Fig.* 56). In the lymph-follicles the cells of the germ-centre are less active and lie in a distinct fibrous reticulum. When the follicle is eventually overcome by the advancing fibrosis it undergoes atrophy, but the large pale reticular cells persist for some time, and might be mistaken for groups of malignant cells. In the surviving acini the epithelium is more hypertrophic than in the other cases, and in several places forms small solid adenomatous-like masses in which the cells have large, sometimes lobulated, nuclei. These areas are practically free of round-cell infiltration, and are really foci of compensatory regeneration.

Case 5.—Female, age 58, admitted to hospital under Mr. John Clay with intense dyspnœa.

HISTORY.—A painless swelling appeared in the neck about four years prior to admission. It was first noticed by her friends, and she is unable to say whether it began diffusely or locally. About a year and a half later she had some dyspnœa, which in the last year has become worse, causing suffocative attacks at night. She has never had dysphagia, but dysphonia developed shortly after swelling appeared, and at times there is aphonia. The tumour has varied in size from time to time, but on the whole was slowly progressive until a year and a half ago, when it enlarged more rapidly. No goitre in family. Medical history without note.

PRESENT CONDITION.—The patient is of fair nutrition and shows no signs of functional thyroid disturbance. Blood-pressure, 218 mm. Hg. Urine contains a trace of albumin. Blood examination, nil. Wassermann, negative. Thyroid is diffusely enlarged and described as being 'as hard as stone'. Skin not adherent. Lymph-nodes not enlarged. The intense dyspnœa demands immediate relief. Clinical diagnosis, malignant struma.

OPERATION.—Total thyroidectomy under local anæsthesia. Gland removed with great difficulty, as it was very adherent to the trachea and surrounding tissues. No undue bleeding. Wound healed per primam. Thyroid tablets given. She has been under observation for the last two and a quarter years without showing any recurrence, and continues in fairly good health.

The thyroid weighs 118 grm.; it is uniformly enlarged and extremely hard. The surface is slightly nodular and the capsule thickened. On section it shows the usual appearances and fibrosis is easily seen.

HISTOLOGY.—This is essentially the same as *Case* 4, but there is less gland tissue and more fibrosis. The capsule is much thickened by hyaline fibrosis, and there is definite evidence of extracapsular infiltration as shown by atrophic striped muscle-fibres and islets of adipose tissue incarcerated in the fibrous tissue. Foci of round cells exist far beyond the confines of the original capsule. Capsular arteries are thickened. (*Fig.* 57.)

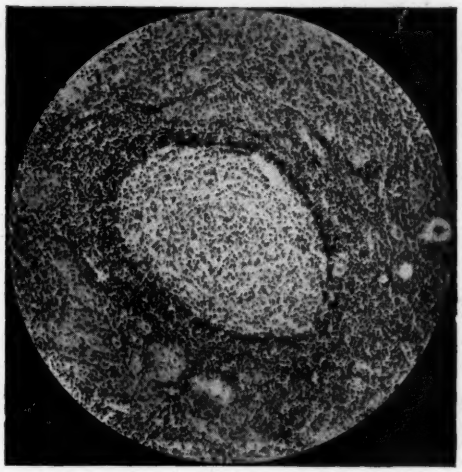

FIG. 57.—*Case* 5. Thyroid. Lymph-follicle with large germ-centre. Diffuse cellularity and solid acini.

Case 6.—Female, age 46, admitted under Mr. T. A. Hindmarsh with dyspnœa and painless swelling in neck. About ten months prior to admission her relatives first noticed the swelling, which has increased slowly. Six months later hoarseness and dyspnœa with suffocative attacks developed. No dysphagia. Previous history without note. No goitre in family. Relief sought for dyspnœa.

ON ADMISSION.—She is a well-nourished woman with no signs of myxœdema or hyperthyroidism. Thyroid diffusely enlarged, rather nodular, and very hard; it moves on swallowing; posterior margins definable. Skin not adherent. Glands not palpable. Blood examination, nil. Wassermann, negative (before and after provocative dose). Clinical diagnosis, cancer of thyroid.

OPERATION.—Total thyroidectomy day after admission. The gland was very adherent to the trachea and was freed with great difficulty. No undue bleeding.

The organ weighs 190 grm.; the appearances are similar to gland from *Case* 5, but the surface is definitely nodular and on section the fibrosis is more obvious (*Fig.* 58). Uneventful recovery. Dyspnœa cured. Thyroid tablets given. Patient is in good health and without recurrence three years after operation.

HISTOLOGY.—Similar to *Cases* 4 and 5, but it is the most advanced case in the series as regards the changes within the capsule. Large areas of the gland are

replaced by a dense hyaline fibrous tissue (*Fig.* 59) in which are sometimes the remains of acini and lymph-follicles. Elsewhere there is the usual round-cell infiltration and lymph-follicle formation. The surviving acini are solid, the epithelial cells being markedly hypertrophied. In addition there are several solid adenomatous-like nodules of compensatory regeneration in which mitoses are seen. The signs of increased functional activity are more striking in this case than in any of the others. Extracapsular extension is shown by the inclusion of muscle and adipose tissue in the very hyaline fibrosis which has thickened the capsule. The capsular vessels are also thickened.

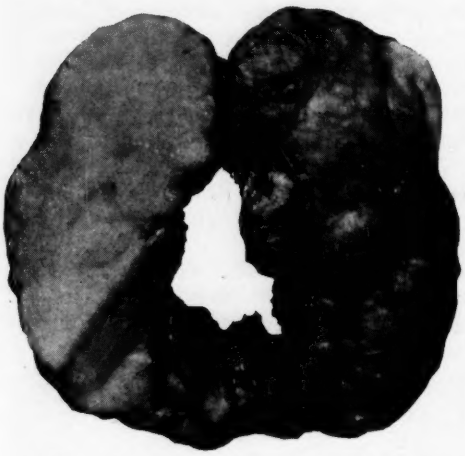

FIG. 58.—*Case* 6. Thyroid weighing 190 grm. removed by operation. The left lobe has been cut to show the solid, white, opaque structure intersected by fibrous bands.

The changes in this gland are instructive because the original histological diagnosis was carcinoma. We believe that this opinion was based on the presence of the adenomatous hyperplasia, the solid acini, and the hypertrophic cells with their large and rather irregularly-shaped nuclei.

SUMMARY OF CASES.

1. Six cases of Riedel's struma, all in females between the ages of 32 and 58 years.

2. Three of these (Nos. 1, 2, 3) are in an early stage, the disease being confined to the interior of the gland, which shows a peculiar round-cell infiltration without appreciable fibrosis. Two (Nos. 1 and 2) had no symptoms; the other (No. 3), with an unusually bulky tumour, had symptoms of compression.

3. Three cases (Nos. 4, 5, 6) are relatively advanced, the process having spread outside the thyroid, but not sufficiently far to prevent removal. In each case there is fibrosis in the gland. Compression symptoms present in all.

4. In 4 out of 5 cases the clinical diagnosis was malignant disease, and in one the pathological diagnosis was carcinoma.

5. Two cases with local enlargement were cured by removal, which was done without difficulty, but in one case with involvement of the whole gland partial removal has not cured. Total thyroidectomy cured two cases with general enlargement.

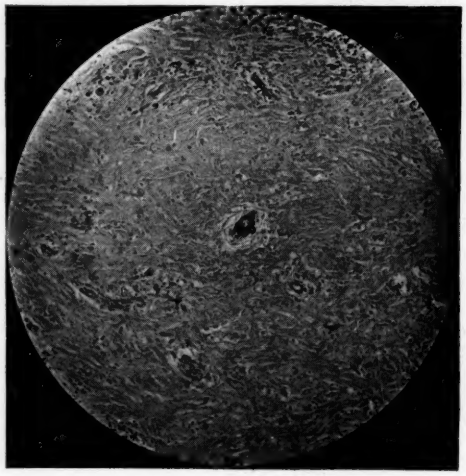

FIG. 59.—*Case* 6. Illustrating advanced sclerosis. No trace of thyroid tissue.

DISCUSSION.

The study and interpretation of the histogenesis in Riedel's struma are important in pathological diagnosis and in explaining certain clinical features of the disease.

The early stage is characterized by a diffuse round-cell infiltration and the formation of numerous lymph-follicles with prominent germ-centres. The cells of the infiltration are lymphocytes, plasma cells, and some phagocytes, all lodged in a delicate reticulum of collagen fibrils and fibroblasts poorly supplied with blood. At first there is little reduction in the amount of parenchyma. A variable number of the acini are filled with colloid and lined by fairly normal cells, but in the majority the vesicular structure is lost. The colloid has disappeared; the cells are hypertrophied, and show all the signs of increased functional activity. Cellular degeneration proceeds simultaneously with hyperplasia, and the débris is removed by phagocytosis. The altered cells on detachment from the acinar wall often fuse together, perhaps round a droplet of colloid, to form giant cells which are eventually removed. These formations have rarely been described, but are mentioned by Hashimoto and Monod. They have been mistaken for tubercle giant cells (Wilke). Numerous in the earlier stages of the disease, they disappear as fibrosis advances. With progressive glandular destruction fibrosis appears, and all stages can be traced in its formation. The sclerous tissue early undergoes hyaline change, and gradually replaces the atrophic acini, the round-cell infiltration, and the lymph-follicles. The germ-centres of the latter persist for some time, and their inclusion in the hyaline fibrous strands produces a picture very like carcinoma. Epithelial hypertrophy is now more evident, and in addition adenomatous foci of compensatory regeneration develop. They form rounded nodules sometimes visible to the naked eye in histological sections. Vesiculation is absent, the mass being formed of solid acini of large cells with prominent, sometimes lobulated, nuclei occasionally in mitosis. There is no cellular infiltration in these foci, and the stroma is similar to normal thyroid. The general structure and arrangement of the nodules leave no doubt as to their nature, and is in conformity with the fact that glandular hyperplasia is readily induced in the thyroid. Hyperplasia seems to have been observed by Silatschek, though he gave it another interpretation, and it is briefly mentioned by Monod, and by Delore and Alamartine. It probably accounts for the pathological diagnosis of carcinoma (Silatschek, Balfour). The change is similar to the compensatory regeneration which takes place in cirrhosis of the liver, and which sometimes passes over into carcinoma. From analogy it is reasonable to imagine that such an event might occur in the hyperplastic nodules of Riedel's struma, but up to the present we have no evidence of this transformation. The absence of myxœdema even with a very cirrhotic gland can only be explained by the glandular hyperplasia, though no doubt in cases in which only a part of the gland is diseased the remainder provides sufficient secretion. Indeed, the glands in myxœdema and in advanced Riedel's struma are very similar, the only essential difference being the glandular hyperplasia in the latter. The remarkable hardness of the gland cannot be explained by fibrosis alone, as the highly cellular tissue

of the early stage produces the same physical change. In the cases described by Riedel and others no mention is made of diffuse cellular infiltration and lymph-follicles. The gland was very cirrhotic and contained foci of round cells and a few vesicles. But in 1912 Hashimoto described four cases of uniform enlargement without symptoms in which the histology was identical with our early cases (Nos. 1 and 2). He considered them as forming a distinct entity—'struma lymphomatosa'—unrelated to Riedel's disease. Ewing, however, has pointed out that Hashimoto and Riedel were describing the early and late stages of the same process, and our series entirely confirms this conclusion.

The pathogenesis of the early stage requires interpretation. The infiltration with its numerous lymph-follicles certainly resembles lymphoid tissue very closely. But there are several difficulties in accepting the view that the tissue is pure lymphoid overgrowth. In the first place, lymph-follicles are known to develop where there is chronic inflammation, viz., Fallopian tube, gall-bladder, endometrium, etc. Recently we have seen an example of this in a man of 29 who had a painless tumour of about 1½ in. diameter, as hard as stone, just beneath the right lower jaw. The overlying skin was red, hot, and adherent. X rays showed no calculus. At operation a drop of pus was found. Microscopically it proved to be salivary gland. There was diffuse fibrosis and round-cell infiltration; much glandular atrophy with some polymorph leucocytes in the ducts. The whole tissue was studded with numerous lymph-follicles containing large germ-centres (*Fig.* 60). The condition was clearly inflammatory in origin, yet very similar in structure to Riedel's struma.

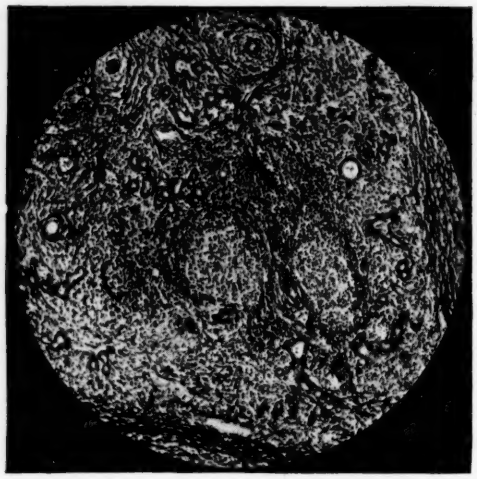

FIG. 60.—Salivary gland in chronic inflammation. The diffuse cellularity, glandular atrophy, lymph-follicles, and fibrosis are similar to the structure of the thyroid in Riedel's struma.

Moreover, lymphoid foci may develop in various affections of the thyroid, but especially in Graves' disease, a condition in which the gland-cells are active. In Riedel's struma the gland-cells are also active, and the presence of lymph-follicles is probably to be associated with this state. Their number and size tend, however, to divert attention from the other changes which, we believe, are essentially a chronic inflammatory process. This is borne out by one of our cases (No. 3) in which there were no lymph-follicles. Here there seems to have been rapid and extensive destruction of the parenchyma and the formation of a definitely granulomatous tissue, which might be mistaken for sarcoma. Plasma cells were present in all our cases, and in much larger numbers than are found in lymphoid tissue. Their excess speaks for an inflammatory process. Lastly, the extension of the process outside the capsule, spontaneous recession of the tumour, and retrogression after imperfect

removal are all clinical features more in favour of an inflammatory process than an involutionary change followed by simple lymphoid overgrowth. Thickening of the arteries of the gland is common, particularly in advanced cases. Some have thought this may be due to syphilis, but there is nothing to support the idea. Either the age of the patient or the sclerotic condition of the gland is sufficient explanation.

Extracapsular Extension.—This develops early, and is present histologically before it is clinically recognizable. In none of our cases was it bad enough to prevent operation. It is described as a tough, leathery, white tissue, prone to bleed. Microscopically it is densely fibrotic or a fibrocellular tissue with round-cell infiltration. In moderately advanced cases it forms adhesions to the vessels, trachea, nerves, and muscles, and shows a marked capacity to infiltrate the tissues, so that at operation it is difficult or impossible to recognize the cervical structures, which are bound in a dense sclerous overgrowth. It may invade the trachea (Riedel), gullet (Ricard), and carotids (Delore and Alamartine). Remarkable extensions have been described in more advanced cases; the infiltration may pass up to the base of the skull (Tailhefer), or more commonly down into the mediastinum (Monod, Bohan, Ricard, Berry), enveloping the trachea, bronchi, and great vessels. Strange to say, the skin is rarely involved, though this has been reported by Monod, and in Berry's case led to ulceration. During life there is cyanosis and intense dyspnœa; the neck is swollen, very indurated, and the normal topography is lost. Cases of this type usually prove fatal whether left to Nature or subjected to operation. The extent of the lesions has been confirmed at autopsy. The infiltrative character of the tissue is so remarkable that in Berry's case the condition was described as an 'infiltrating fibroma', yet microscopically there was no malignancy. For a summary of the various difficulties and accidents connected with such cases the reader is referred to *Table I.*

Lesions in Larynx and Trachea.—Compression and paretic lesions are common; but it has often been remarked that the dyspnœa may be out of proportion to the size and site of the tumour. St. George's case is instructive on this point. The patient died of erysipelas following tracheotomy for severe dyspnœa. At autopsy the thyroid was not enlarged, but adherent to, and constricting, the trachea. Microscopically it was very fibrous. This case suggests that fibrous contraction in the gland itself may sometimes be the cause of dyspnœa. Inflammatory lesions have been recorded in three cases. One of Riedel's patients returned twelve years after operation cured of his struma, but with severe dyspnœa from subglottic stenosis 17 cm. from the teeth. Silatschek describes an acute tracheitis and narrowing of the first four tracheal rings. Monod found ulceration below the glottis and at the tracheal bifurcation in a case which died. He concludes that Riedel's struma is not a primary disease of the thyroid at all, but is secondary to a tracheal lesion which is probably syphilitic. There is nothing to support Monod's view. If it were true, inflammatory lesions should be common, but the larynx and trachea are usually normal, and this has been confirmed post mortem in one of our cases and by other writers. The cases of Riedel, Silatschek, and Monod all had extracapsular lesions which more probably invaded the trachea secondarily, in the same way as they are known to attack other structures.

Table I.—**SUMMARY OF 23 CASES OF RIEDEL'S**

Author	Sex and Age	Duration and Site	Symptoms	Wassermann	Extracapsular Lesions
Riedel, 1883	M. 42	6 months, diffuse ..	Dyspnœa	O	Adherent to vessels on both sides .. ..
Riedel, 1896	F. 23	1 year, diffuse ..	Dyspnœa, dysphagia	O	Adherent to vessels and recurrent nerves
Riedel, 1896	M. 29	6 weeks. Right lobe first, then rest of gland	Dyspnœa	O	Adherent to muscles, vessels, and nerves..
Berry, 1883. (Bowlby's case)	F. 42	3 years, diffuse ..	Dyspnœa, dysphagia, dysphonia ..	O	Adhesions to muscles, vessels, nerves, gullet, trachea. Extension to mediastinum ..
Berry, 1898	F. 40	5 weeks. Right lobe	'Shooting pains' in neck	O	None
Berry, 1899	F. 63	Symptomless goitre for many years. Diffuse	Dyspnœa for two months	O	Adhesion to trachea, left carotid, and skin
Berry, 1921	F. 46	2 months. Hazel-nut nodule in right lobe	Some pain ..	O	None
Tailhefer, 1898	M. 30	3 months. Left lobe	Aphonia	O	Adherent to left carotid sheath and extension to base of skull
Ricard, 1901	M. ?	Left lobe	Dysphonia, dyspnœa, dysphagia ..	O	Adherent to muscles, vessels, vagus, trachea, gullet; behind clavicle .. ..
Hashimoto, 1905	F. 55	4 weeks, diffuse ..	Slight dysphagia and dysphonia ..	O	None
Hashimoto, 1907	F. 61	7 months, diffuse ..	None	O	None
Hashimoto, 1907	F. 45	3 weeks, diffuse ..	None	O	Fixed at its base
Hashimoto, 1909	F. 40	6 weeks, diffuse ..	Slight dysphonia ..	Negative	None
St. George	F. 35	4 months, diffuse ..	Dyspnœa	O	Adherent to trachea
St. George, 1905	M. 25	3 months. Right lobe	Dyspnœa, dysphagia	O	Adherent to trachea, gullet, recurrent nerve; behind clavicle .. .. ..

O = No statement.

DISEASE COLLECTED FROM THE LITERATURE.

TREATMENT	CLINICAL DIAGNOSIS	PATHOLOGICAL DIAGNOSIS	RESULT
Walnut-sized piece removed	Malignant	Chronic inflammation	Tumour receded. Dyspnœa gone in 6 months. Died 15 months after operation from nephritis
Portion removed ..	Malignant	Chronic inflammation	Dyspnœa relieved. Died suddenly 2 months later from (?) embolism
Small piece removed ; no relief. 6 months later another small piece removed. Dyspnœa improved	Chronic inflammatory ..	Fibrosarcoma	Returned 12 years later with dyspnœa from subglottic stenosis. No trace of goitre
Division of isthmus. Tracheotomy	Malignant	Chronic inflammation	Died shortly after tracheotomy. Post-mortem
Right lobe removed ..	? Malignant	Chronic inflammation	Alive and well 2 years later
Inoperable. Tracheotomy	? Inflammatory ? Malignant	Chronic inflammation	Death from septic pneumonia 6 days later. Post-mortem
Right lobe removed ..	? Cyst ? Malignant	Chronic inflammation	Cured
Small bit removed ..	Cancer	Chronic inflammation	Secondary hæmorrhage from carotid. Hemiplegia. Tumour had gone about a year later
Removed piecemeal. Thoracic duct injured	Cancer	Fibrous degeneration	Recovery
Complete removal ..	Struma fibrosa	Struma lymphomatosa	Well 2 years later
Complete removal ..	Parenchymatous goitre	Struma lymphomatosa	Well 4 years later
Complete removal ..	Struma fibrosa	Struma lymphomatosa	Well 4 years later
Complete removal ..	Malignant	Struma lymphomatosa	Well 2 years later
Tracheotomy	O	Chronic inflammation	Died on 5th day of erysipelas and hæmorrhage. Post-mortem
Removal of right lobe	O	Chronic inflammation	Alive and well 4 years later

[*Continued on next page*

Table I.—**SUMMARY OF 23 CASES OF RIEDEL'S**

Author	Sex and Age	Duration and Site	Symptoms	Wassermann	Extracapsular Lesions
St. George, 1922	M. 31 (Author himself)	5 months, diffuse, but especially right lobe	Dyspnœa, dysphagia	Negative	Right lobe adherent to muscles and trachea
Silatschek, 1908	M. 32	1½ years. Right lobe, then rest of gland	Periodic aphonia, then dyspnœa. Gland varied in size	Negative	Adherent to surrounding parts .. ..
Spannaus, 1909	M. 32	Symptomless goitre for 7 years ..	Dyspnœa and dysphonia last 6 months	Negative	Adherent to vessels, vagus, trachea, and gullet .. ..
Delore and Alamartine, 1910	M. 39	5 months. Right lobe	Dysphonia, dysphagia	O	Adherent to trachea, vessels, muscles, and recurrent nerve. Carotid infiltrated and softened ..
Poncet and Leriche, 1912	M. 60	6 months. Isthmus, and then whole gland	Dyspnœa	O	Gland fixed .. ..
Balfour, 1918	F. ?	Diffuse	Tracheal pressure	O	Gland fixed .. ..
Monod, 1921	F. 30	5 months. Left lobe, then rest of gland	Dysphagia, dyspnœa, dysphonia ..	Negative	Diffuse infiltration of neck and upper mediastinum .. ..
Bohan, 1924	F 38	4 months, diffuse ..	Dyspnœa. Cough. Dysphagia. Pain in neck	Negative	Adherent to trachea. Mediastinal extension by X-ray .. ..

O = No statement.

Frequency.—The disease is rare. We have collected only 23 cases from the literature (1896–1924). St. George states on the authority of Pemberton that 48 cases were seen in 10,500 thyroidectomies in the Mayo Clinic. Riedel saw 3 in 1064 goitres. Ewing (private communication to one of us) has had 8 cases. The last 150 thyroids examined in our department did not yield a case. Nevertheless the condition is certainly not as rare as these figures suggest. A more critical examination of cases of 'inoperable cancer' and 'cured cancer' would, doubtless, swell the number of Riedel's struma. Spontaneous recession may account for a few cases. The histology has been mistaken for cancer or sarcoma. Indeed, there are few diseases in which the clinician, the surgeon, and the pathologist can all err in making a diagnosis of malignancy; yet this happened in Balfour's case—time alone proving the true nature of the disease.

Sex and Age.—In our 23 collected cases 10 were males. The youngest was 23 and the oldest 63 years. Two-thirds of the cases occur between the second and fourth decades. There are verbal statements that the disease

DISEASE COLLECTED FROM THE LITERATURE—*continued.*

Treatment	Clinical Diagnosis	Pathological Diagnosis	Result
Right lobe removed	Calcified adenoma ..	Chronic inflammation	Alive and well 1 year later
Biopsy for diagnosis ..	Malignant	Cancer, then chronic inflammation	Tumour disappeared entirely some months after operation
Portion of left lobe removed	O	Chronic inflammation	Tumour disappeared 2 months after operation
Removal of right lobe	Malignant	Chronic inflammation	Died of hæmorrhage from carotid 4 days after operation
Isthmus divided ..	O	Cirrhosis	Thyroid normal in 1 month
Irremovable	Cancer	Cancer	Alive and well 7 years later. Gland receded
Biopsy. N.A.B. course did not cure. Tracheotomy	Malignant, then cellulitis ..	Riedel's disease..	Died some weeks after tracheotomy. Post-mortem
Isthmus and right lobe removed. No improvement. Tracheotomy ..	Malignant or acute thyroiditis	Chronic inflammation	Two months after tracheotomy tumour had disappeared. Attributed by author to removal of septic teeth

may develop in childhood (Cordua, Riedel), but we have found no description of a case.

Etiology.—This is unknown. Syphilis and tubercle can be excluded with certainty. In 5 of our cases examined for tubercle bacilli, spirochætes, and the common bacteria, the sections were negative. Animal inoculation is negative (Poncet and Leriche). The Wassermann was negative in all cases in which it was done, including 3 of our own. Bohan thinks dental infection may be a factor, because the tumour disappeared in one case after removal of three teeth with apical abscesses; but this may have been due just as well to spontaneous retrogression. We have been unable to collect any evidence that the condition is an involution following a previous goitre. In a few cases there has been a history of goitre or Graves' disease in other members of the family. We believe that the disease is a chronic inflammatory process of a granulomatous nature, and this view receives ample support from its clinical characters and the anatomical changes in the gland.

As to the relation, if any, between Riedel's struma and fibrous atrophy

of the adrenals, we are unable to express an opinion, except to say that the anatomical changes are strikingly similar. That the alterations in the thyroid in our case are not the result of some disturbance in the gland following adrenal disease seems to be proved by Huebschmann's observation that in fibroid atrophy of the adrenals the thyroid is normal. At any rate our case suggests the possibility that the factor responsible for Riedel's struma may also attack other members of the endocrine glands.

Our special thanks are due to Mr. J. Clay, Mr. T. A. Hindmarsh, Dr. Pearson, Mr. Collingwood Stewart, Mr. Grey Turner, and Mr. R. J. Willan, whose courtesy and help have made it possible to record the clinical histories of their cases.

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THREE CASES OF ANEURYSM OF THE AORTA TREATED BY WIRING.

[These cases appear to be worthy of publication, as they deal with a method of treatment which is still upon its trial; they illustrate some of the difficulties of the operation, and they are a continuation of a series which has already been published in the Journal (Vol. ix, pp. 27–36).—Ed. B.J.S.]

I. ANEURYSM OF THE ABDOMINAL AORTA.

By G. H. COLT, Aberdeen.

D. R., 78, a retired marine engineer, was admitted to the Aberdeen Royal Infirmary under my care on Dec. 14, 1923, and died Feb. 13, 1924. For about fourteen months the patient had suffered from pain in the back. The onset had been gradual. The pain was sometimes of a gnawing character and was fairly constant. He was able to ease it by lying face downwards. For five weeks before admission he had suffered from intermittent attacks of cramp in the abdomen accompanied by sickness and vomiting, and during this time his bowels became increasingly constipated. The pain was most marked about half an hour after food, and was related more to the quantity than to the kind of food taken. During the last year he had become progressively thinner, and for about a month had noticed a swelling in the middle of his abdomen. In the course of his profession the patient had visited many lands. He denied having had venereal disease, and was the father of a healthy grown-up family of four.

On Examination.—The patient was a spare and rather feeble man, but in general remarkably healthy. The tongue was dry and furred and the appetite poor. The respiratory excursions were equal on the two sides. The percussion note at both bases was impaired and the breath-sounds were subdued. There were no moist sounds. My colleague, Dr. W. F. Croll, who saw the patient with me, reported: Pulse 72, occasional intermissions, pulse full between beats. Systolic blood-pressure 160 mm. Hg, diastolic blood-pressure 140 mm. Hg, pulse-pressure 20 mm. Hg, vessel-walls slightly degenerated. The low pulse-pressure suggests myocarditis. Extended open impulse. Apex in 5th interspace about 4 in. from mid-sternum. Impulse rather thrashing in character. No enlargement of right side of heart made out. Sounds good all over. Slight accentuation of second aortic sound. A faint murmur accompanies first sound at all areas. Electrocardiogram shows ventricular premature beats arising in the right ventricle, otherwise the electrocardiogram is perfectly normal in every respect. The femoral pulse is quite strong. The delay between the apex impulse and the femoral pulse is not increased beyond the normal 0·24 secs. The Wassermann reaction was negative.

The abdomen showed visible pulsation in the region of the umbilicus, and on palpation a rounded swelling of about 5 in. diameter with the umbilicus as

its mid surface-point was made out. The pulsation on some days was expansile and on others was not definitely expansile. It remained unaltered when the patient was in the knee-elbow position. A definite soft systolic bruit was audible, sometimes to the left and sometimes to the right of the umbilicus. It did not disappear or change in character when the patient sat up; but as the bruit was faint, Corrigan's sign could not be said to be negative. No thrill was made out. The X-ray examination in the lateral position showed no erosion of the vertebræ. The anterior rounded body of the mass was well defined. The opaque-meal examination showed that the pyloric tube was displaced upwards and to the right, and that the outline of the stomach was irregular. There was no definite evidence of delay or of a growth causing obstruction.

The case was diagnosed as one of saccular abdominal aneurysm arising from the region of the cœliac axis, but situated rather lower than is usual in such a case. The absence of a thrill and only the occasional presence of a soft bruit rendered it probable that the opening into the aorta was not a small one. According to previous observations, confirmed post mortem, the harsher the bruit and the greater the thrill, the more nearly circular and (within limits) the smaller is the opening into the aorta, provided the contents of the sac are mostly liquid blood. It is under these conditions that a negative Corrigan's sign would render the diagnosis doubtful. There was no sign of aneurysm elsewhere.

The patient rested in bed and had a light but nutritious diet. Fluids were not restricted. His general condition improved a little. A fortnight after admission there was a sudden increase in the size of the mass, and the pulsation became more marked. There was no sign of hæmorrhage, and the symptoms decreased again in five days. This attack was not repeated, although it is not unusual to see them occur at intervals of two to three weeks. The probable explanation lies in a leakage of blood taking place between the sac and the clot lining the walls. There were intermittent attacks of abdominal pain from which the patient obtained some relief by changing his posture, but his rest was much disturbed and his general condition began to get worse.

Operation.—On Feb. 5, 1924, under general anæsthesia, the abdomen was opened through a right paracentral incision and the diagnosis verified. The aneurysmal sac projected from the aorta through and under the transverse mesocolon. The third part of the duodenum was adherent to its upper anterior surface. The lateral parts of the sac were harder than the anterior part, where the sac felt thin. A purse-string suture of linen thread was placed here, the part was punctured, and a wisp of wires 3½ in. long, having a total clotting surface of 2½ square in., was gently inserted. The usual precautions were taken, viz., to see blood spurting from the cannula and to feel the lie of the clot in the sac so that the arrangement and expansion of the wires could be to some extent controlled. A small amount of clot, felt with the cannula, lay on each side. Most of the interior of the sac appeared to contain liquid blood. The cannula was withdrawn until the orifice was estimated to be about an inch inside the sac at the time the wisp was inserted. The purse-string suture was tied and the abdomen closed. Excluding the

anæsthetic, the whole operation took twenty-five minutes, and could have been done more rapidly.

The patient had little pain or discomfort after the operation, and made good progress for a week. On Feb. 12, at 9 a.m., he began to vomit and continued to vomit duodenal contents copiously all day. The vomiting stopped during the night, but at 7 a.m. on the next day he suddenly turned grey, and died in about two minutes, without showing any distress or cyanosis, seven days and twenty hours after the operation.

POST-MORTEM EXAMINATION.—A partial post-mortem was allowed. There was acute dilatation of the stomach and duodenum as far as the third portion, where it was adherent to the sac of the aneurysm. The sac arose from the aorta by an irregular opening measuring $2\frac{1}{4}$ in. vertically and $1\frac{3}{4}$ in. horizontally. Its axis was situated obliquely, projecting forwards, upwards, and to the left, and measured $4\frac{1}{2}$ in. The horizontal measurement was $3\frac{1}{2}$ in. and the antero-posterior $2\frac{1}{4}$ in. There had been no rupture of the sac, no formation of dissecting aneurysm, and no leakage at the site of puncture. The sac was filled with dense firm clot, adherent to the walls, but for the most part of recent appearance. That on the left anterior part was $\frac{1}{2}$ in. thick, red and partly laminated. The clot near the aorta was flaky, and some of it had been separated before I saw the specimen, but otherwise the whole aneurysm was full of dense, firm, even clot in which the wisp lay expanded equally. The ends of the wires for about half an inch were free of clot and lay close to the opening into the aorta. On removing some of the clot with a scalpel from between the wires the section was found to be firm and pale, and the clot could only be removed by cutting it. Microscopically, it showed fibrin, but no organization. The walls of the aorta and iliac vessels showed atheroma.

It was unfortunately my lot to be away for a day at the time the dilatation of the stomach occurred and when the post-mortem examination was made. Stomach lavage or an anterior gastro-enterostomy might possibly have saved this patient. By the time I saw the specimen the surrounding parts had been removed, including the bifurcation of the aorta, and the details of the arrangement of the arteries and veins with respect to the sac could not be ascertained. (It is better to harden these specimens *in situ* and then examine them by cutting a window or windows before proceeding to a more detailed preparation of the specimen. They should not be cut in half, as the wires become displaced.) Some of the flaky portion of the clot near the opening into the aorta had also got rubbed off. Apparently there was no embolus and no thrombosis of any of the mesenteric vessels. It is difficult to avoid the conclusion that, had this patient survived the acute dilatation of the stomach, he would have been cured, but whether the large opening into the aorta would have shed emboli or not it is difficult to say. It is clear from the way in which the wires are arranged that the major part of the contents of the sac was liquid when the wires were inserted, and that in approximately eight days nearly the whole of the contents had become solid, and in due course would have become organized.

In most of the cases of natural cure—a subject I hope to consider somewhat exhaustively at a future time in connection with the clinical duration of the disease—the usual condition found in a saccular aneurysm is that

the solid mass of laminæ shows a concave, smooth surface continued close up to the margin of the orifice and sometimes extending into the aorta. The great mass of evidence, notably in internal arteriovenous aneurysm, is against the occurrence of the detachment of organized clot.

Since the last summary of results of the 16 cases which appeared in the BRITISH JOURNAL OF SURGERY in 1921[1], we have now to add five more (Nos. 17 to 21) as mentioned below. General Sir M. P. Holt has fortunately called to mind two cases which had been missed. One of these, a case of subclavian aneurysm, in which the patient died five years later from hæmorrhage, will not be included here; the other is No. 17 below. In a third, a male, F. E. N., 49, a boiler-scraper, with a strongly positive Wassermann reaction, there was a saccular aneurysm of the ascending arch the size of a large orange; death occurred from dyspnœa twenty-eight days after operation, and very little ante-mortem clot was found round the wires. The case has not been published, but from the notes I have seen it appears that death was not hastened by the operation. The other three cases are recorded in this number of the JOURNAL, and I am greatly indebted to the authors for having allowed me to see their manuscripts so that the summary could be brought up to date.

17. Male (abdominal), died of peritonitis 7 days after operation (Lentaigne).
18. Female (ascending aorta), died 8½ months after first operation (Wakeley).
19. Male (abdominal), died 8 days after operation (Colt).
20. Male F. E. N., 49 (ascending arch), died 28 days after operation.
21. Female (abdominal), died 6 weeks after first and 12 days after second operation (Marshall).

In the absence of any authoritative statement of the clinical duration of aneurysm it is difficult to assess the value of any particular method of treatment. While America holds the world's records for thoracic aneurysm treated by wiring and electrolysis, Dublin holds the record for abdominal aneurysm treated by wiring alone. The medical profession in Dublin in the past have added so greatly to our knowledge of the disease that it is most fitting that Sir William Wheeler's first case, a male (T.), age 38, with a positive Wassermann at the time of operation on Aug. 30, 1910, should be alive and working in a brewery to-day, 14 years and 6 months later. His second case, a male of 30, lived in good health and died 4 years and 8 months after operation from leakage of a secondary dilatation; the sac post mortem was solid (King-Fretz). Lawson's patient lived 10½ years; no details could be ascertained of the pathological state. Up to the present time, in the remaining eleven cases of abdominal aneurysm, one patient lived a year, one some months, one six weeks, and the other eight died within nine days of the operation, *at least three of them from acute dilatation of the stomach.* Some of the others may have died of this, but the accounts are not complete. The three cases were Wheeler's third case, Marshall's, and my own, and it is clear that the condition arises either as a result of the change occurring in a consolidating sac or as a result of some nervous or vascular change induced by the trauma. In Marshall's case the distention was always threatening, but never excessive until twelve hours before death.

Box and Cuthbert Wallace,[2] reviewing 18 fatal cases, say: "The actual

exciting agent is obscure. The condition has appeared to follow or be associated with trauma, surgical operations, possibly the administration of chloroform, lung disease, empyema, retroperitoneal suppuration, and, especially, acute infective fevers and other febrile conditions of obscure origin . . . It is probable that pyloric obstruction, spasmodic or otherwise, has no part in producing the condition, for in no instance has mechanical obstruction been demonstrated, and in four of the recorded cases the duodenum was dilated as well as the stomach ". Morris[3] considers that the secretion of such enormous quantities of gastric fluid may be due to an error of nerve influence or to an alteration in the circulation in the organ. It cannot be said that our knowledge is much greater to-day. That the condition has followed operations involving the solar-plexus area and has occurred after operations on the kidney—perhaps from the pressure made to bring the organ into the wound—does not necessarily show its cause. With its great mortality it will turn the scale in cases of the wiring of abdominal aneurysm, and it seems to me that in such cases, and certainly when the sac is in the region of the cœliac axis, a gastro-enterostomy should be done at the time of the wiring. In most of such cases the anterior operation will necessarily be chosen.

The present condition of *Case* 5 (female, aneurysm of ascending part of arch) is that the patient is living and shows pulsation in the chest and suffers pain. This is 5 years and 10 months after the first, and 4 years and 7 months after the second operation (Sir D'Arcy Power).

It may be mentioned here that in 41 fatal cases of aneurysm of the abdominal aorta investigated consecutively and which had not been treated surgically, the mean age was 35·6 years (standard deviation 7·9), the mean 'clinical duration' 13·5 months (standard deviation 9·6), and that the longest noted was only 42 months. A large number of cases have been investigated since these figures were compiled, and I hope to be able to give them at a later date. Sir William Wheeler's two successful cases and Lawson's case are entirely beyond these figures, and so were the cases recorded by Langton (11 years 10 months) and Morse (4 years) wired by the older method. It is now clearly proved that the dull-gilt wisp is sufficient to initiate active clotting in a saccular aneurysm even in an actively syphilitic patient, and that it is unlikely to project through the opening of the sac. The wires do not become dissolved or broken, and appear to cause no trouble after many years. It would appear that the employment of electrolysis is not essential to start the clotting, and the experiments of Dawson Turner[4] amply confirm this. If electrolysis is employed, he recommends zinc as the electrode. Macdonagh[5] may be read in this connection. A simple way would be to coat alternate strands of the wisp with zinc.

II. ANEURYSM OF THE ABDOMINAL AORTA.

By C. JENNINGS MARSHALL, London.

Mrs. L. G., age 46, a widow, nulliparous, referred by Dr. F. G. Chandler, had undergone bilateral salpingectomy twenty years ago following a miscarriage. Her mother had died of phthisis. There had been pain in the left

side and in the middle of the back for nearly two years; the onset was after an attack of influenzal pneumonia. It had become much worse since attacks of 'dysentery' four and two months back; there was constant aching, with exacerbations, the patient was unable to lie upon the left side, and during the last two weeks had had practically no sleep, and was beginning to find the suffering utterly intolerable. She begged for something to be done, at whatever risk.

On Examination.—There was a swelling in the epigastrium, slightly to the left of the middle line, about the size of a tangerine orange, with expansile pulsation and a pronounced thrill. The femoral pulses were present and not obviously delayed. There was tenderness over the lower dorsal vertebræ, but no angulation was evident. The physical signs of the swelling did not alter in the knee-elbow position. Radiography showed a rounded opacity in the epigastrium corresponding with the swelling; no vertebral erosion could be made out. Dullness and defective air entry were noted at the left base. The Wassermann reaction was negative.

The diagnosis was made of aneurysm of the abdominal aorta, at or below the origin of the cœliac axis. In view of the thrill, it was thought a comparatively saccular form might be present, and therefore that the case was favourable for some attempt to induce coagulation. Wiring was agreed upon.

Operation.—Under local anæsthesia a left paramedian epigastric laparotomy was performed. The gastrohepatic omentum was painted with novocain 1 per cent, and then divided for a few inches. The stomach was drawn down gently, and the aneurysm came into view above the pancreas, which was slightly pushed forwards. Over a prominent area a small quantity of novocain was injected, and then a purse-string suture of fine silk was inserted and left loose. The aneurysm was now punctured with an upwards and backwards thrust; the trocar appeared to be freely mobile in the sac, as if there were little, if any, clot present; on removal of the stilette blood spurted over the end of the operation table. The loaded cartridge was then engaged in the cannula and the blunt stilette pushed onwards. To one's consternation jamming occurred. The cartridge was removed, the opening in the cannula stopped with the finger, the wisp removed from the cartridge, and then fed into the cannula wrong end first. The blunt stilette was then able to push it inside the aneurysm; the cannula was removed and the purse-string tied. There was no leakage of blood, and the abdomen was closed.

The unfortunate contretemps was due to defective manufacture of the cannula and cartridge, so that after the electroplating they did not register exactly. In the small gap so caused at the breech end the ends of the wisp, tending always to expand, had impacted. As the wisp was finally introduced wrong end first, it was, of course, to be feared that expansion would be defective, the ends of the wires being expected to catch against the aneurysmal wall and in any thrombus already present. This was substantiated by a radiogram taken ten days after the operation (*Fig.* 61).

The patient slept poorly the night after operation; for a few days there was considerable flatulent pain, and then there was pronounced abatement of the symptoms. The aneurysm, though no smaller, seemed to be distinctly harder.

Three weeks after the wiring, however, the pain again became intolerable, worse, if anything, than before; the swelling was distinctly larger, and had extended downwards. The patient got no sleep, could eat little, and constantly complained of flatulent pain, though there was no intestinal distention.

A second wisp was introduced a month after the first, the same technique being used; the apparatus had been altered and no hitch occurred. There was again relief for three or four days, but then the pain returned and became very severe, both in the back and in the abdomen. The patient constantly urged that there was flatulence which should be relieved by puncturing the

FIG. 61.—Aneurysm treated by wiring.

bowel to let the gas out. Death took place twelve days after the second operation; during the last twelve hours there was actually great abdominal distention.

POST-MORTEM EXAMINATION. This was made by Professor A. Piney. The upper abdomen contained blood to a small amount—about 8 oz. There was a most striking acute dilatation of the stomach and duodenum down to the third stage of the latter, where there appeared to be compression between the aneurysmal sac and the superior mesenteric vessels. The sac (*Fig.* 62) was the size of a fist, having extended downwards and to the right, carrying forwards the pancreas and the duodenum at its lower part. The origin appeared to be immediately below the cœliac axis. The neck was comparatively narrow, about $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. Slight leakage had taken place on the right

side, nearly 2 in. from the point at which the trocars had been introduced. The whole of the aorta showed severe patchy mesarteritis, and there was a second small aneurysm at the level of the left bronchus which had been compressed, with collapse and carnification of the lower lobe of the left lung.

The first wisp was seen to have reached to the neck of the sac and its 'handle' to be protruding slightly into the lumen of the aorta. It had expanded but little, the wires being partly caught among each other, partly held by the walls of the sac. The whole surface of the wisp, however, was practically covered by very adherent flakes of firm fibrin which were most difficult to peel from the wire. The second wisp, its end in contact with the first, had partly expanded and was embedded distally in recent thrombus which almost completely filled the aneurysm, and projected by a small tongue into the lumen of the aorta. The cut surface of this thrombus showed irregular whitish laminations, and its periphery was becoming adherent to the wall of the sac. In one place only could organized clot be detected, viz., as a thin layer anteriorly under the pancreas.

FIG. 62.—Post-mortem appearance of aneurysmal sac.

(Reproduced by permission from Marshall and Piney's "Textbook of Surgical Pathology": London, Arnold & Co.)

There was no aneurysmal affection of the posterior part of the aorta, no vertebral erosion. The viscera otherwise showed no striking abnormality. In *Fig.* 62 the wisps are shown displaced into the aorta. This occurred in sectioning the specimen. In the undisturbed state the expanded wisp lay entirely embedded in the whorled clot. The *Spirochæta pallida* was demonstrated by the Levaditi method in sections of the aortic wall.

There seems to be little doubt that, as a result of the introduction of the wisps into the aneurysm, the sac had become filled by thrombus which was in early process of organization. Very careful investigation was made to see whether the puncture had led to rupture, and the question could be answered

very definitely in the negative. The acute dilatation of the stomach may have been due, as is usually stated, to the pressure on the third stage of the duodenum; in this case there is, however, the possibility of severe disturbance of the splanchnic nerves by the sac. The persistent 'flatulent' pain seems strongly suggestive in this connection.

Despite the fatal outcome, one feels that the post-mortem findings fully justify the use of this method in abdominal aneurysm, particularly if saccular; and one would recommend its adoption in other cases.

III. ANEURYSM OF THE ASCENDING AORTA.*

By Cecil P. G. WAKELEY, London.

Wm. A., male, age 31, married, blacksmith and ex-sailor, admitted to King's College Hospital, Nov. 26, 1923; died Aug. 16, 1924.

About six months before admission, patient had a fall on the right shoulder, and shortly afterwards noticed a swelling in front of the chest, which gradually increased in size. The swelling has been associated with a continual aching pain in the chest, which was at its worst during the evening, and was just severe enough to keep him awake at night. Recently the pain had been more severe, and caused loss of appetite. The patient denied venereal disease, was a moderate smoker, and drank beer in moderation, but no spirits. Father and mother both alive and well, and he had two healthy children.

On Examination.—The patient was a man of middle height and beyond average physique. There was a swelling on the upper anterior thoracic wall just to the right of the mid-line, about the size of an orange. The skin over the swelling was tense, red, and shiny. The swelling was visibly pulsatile, the pulsations corresponding in time to the apex beat. On palpation it was elastic, and the pulsation was felt together with the transmitted vibration of the closure of the heart valves; it was dull to percussion. On auscultation the heart sounds were heard somewhat distantly, and there was a soft systolic murmur, heard best over the lower pole of the swelling.

The patient did not suffer from shortness of breath. He had had a cough since leaving the navy eighteen months ago, which had got worse lately. He was not discharged from the service on account of aneurysm. The cough was dry, there was no phlegm, and at no time had the patient coughed up blood. There was diminished air entry in the right lung, most marked in the scapular region posteriorly. There had never been any difficulty in swallowing, and he had never noticed any change in his voice. The cords were normal. The Wassermann test was positive. Pulse 120, respirations 24, temperature 97°.

The diagnosis of aneurysm of the first part of the aorta was made; the sac had perforated the chest wall and was subcutaneous.

Operations.—On Nov. 30, 1923, under C. E., the lower limit of the swelling was exposed by a curved incision following the fifth rib, and a flap dissected up. A No. 2 wisp of wire from a Colt's apparatus was introduced into the

* This case has also been recorded in the *Proceedings of the Royal Society of Medicine*, 1923–24, Clinical Section, p. 18.

aneurysm from below. The character of the pulsations changed from expansile to thrusting. The after-progress was uneventful, the only feature about the swelling being the change in character of the pulsation. Cough and pain persisted. The wire was demonstrated in the sac by X rays.

On Dec. 31, 1923, the operation was repeated, another wisp of wire (No. 2) being introduced; the anæsthetic was rectal ether.

On Jan. 12, 1924, the swelling appeared to be somewhat smaller than on admission. The patient was free from pain, and the cough was much better. The blood-pressure was 95 systolic and 65 diastolic.

On Jan. 25 the patient got up and felt no ill effects on slight exertion. At this time a systolic murmur replaced the first sound at the apex, and a quiet murmur, systolic in time, was audible over the upper part of the tumour. Electrocardiogram was normal. Medical treatment consisted in administration of potassium iodide and mercury. The patient was discharged.

The patient was re-admitted on May 21. There was now a second swelling slightly above and to the left of the original one, and smaller. The original swelling had not increased in size since his discharge. The second swelling was similar to the first, and on auscultation over it a blowing systolic murmur was audible. Pulse regular, 110, respirations 28, temperature 97·6°.

On May 23 under gas and oxygen anæsthesia two No. 2 wisps of wire were inserted, one into either swelling. For a short time afterwards the pulse improved in volume, and the swelling on the left decreased in size and became less expansile. During this time the temperature rose in the evenings, and a small collection of pus formed under the skin. This cleared up satisfactorily, and the patient was discharged on June 28. He was re-admitted on Aug. 16 in a weak condition, with a dry, intractable cough. At the site of operation there was an unhealed wound from which blood leaked continuously. The bleeding rapidly became more profuse, and the patient died on Aug. 16, eight and a half months after the first operation.

Post-mortem Examination.—The pericardium was obliterated by dense adhesions, which were universal. There was no thickening of the parietal pericardium. The mitral valve admitted three fingers. The aortic valve was normal and competent.

There was a large aneurysmal sac on the ascending aorta. The cavity was about 4 in. in diameter, and the mouth, which was situated about 1 in. above the aortic valve, was about 1½ in. in diameter. This cavity passed forwards to the front part of the sternum, and was filled with post-mortem—'chicken-fat'—clot. The walls of the sac were covered with ante-mortem laminated clot. The aorta was dilated, and formed a cavity which commenced 1 in. above the aortic valve and extended in a backward direction towards the root of the left lung for a distance of about 3 in. This cavity also contained post-mortem clot. There was an abscess cavity, which did not communicate with the aorta, opening on the chest wall at the site of the aneurysm.

There was syphilitic inflammation of the root of the aorta, but only a slight degree of atheroma was present. The coronary arteries were patent. The aneurysmal sac contained the wisps introduced at the operations and

laminated clot had formed around them. All the wisps had expanded properly, and no part of any of the wires was uncovered.

The pleuræ showed some recent adhesions and contained a little fluid. The apex of the right lung was adherent to the chest wall, and the upper lobe had collapsed owing to the pressure of the aneurysm. The right middle lobe was adherent to the mediastinum in contact with the sac. There was a small scar on the right kidney.

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EXTRAVASATION OF BILE.

By ZACHARY COPE, London.

(Being a Hunterian Lecture delivered before the Royal College of Surgeons of England on February 2, 1925.)

The body is provided with various kinds of tubes which convey the different fluids to their appointed destination. As the result of injury or disease any of these tubes may leak, so that extravasation of a fluid is a common pathological phenomenon; in the case of blood it is an every-day occurrence, with urine not an uncommon happening, whilst it is only too frequent for the surgeon to have to deal with extravasation of gastric or duodenal contents. Extravasation of bile is less common, but not very rare; yet it is most difficult to find anything more than a passing reference to the subject in any but the Continental literature. English and American surgeons must be well acquainted with the condition, but have, so far as I can find, not thought it worthy of their detailed consideration. This statement applies with particular force to that variety of extravasation in which no perforation of the biliary tract is discovered at autopsy or operation. When a series of such cases came under my observation, therefore, a further consideration of the subject seemed necessary.

The anatomical course of the bile-duct is well known. After leaving the liver by the right and left hepatic ducts, the bile flows through the common hepatic duct which is formed by their junction; the common hepatic is joined by the cystic duct, and the combined trunk—the common bile-duct—courses down in the right free edge of the gastro-hepatic omentum, behind the first part of the duodenum, and behind or through the head of the pancreas, to join the second part of the duodenum. The gall-bladder may be regarded as a blind dilated recess of the cystic duct.

The peritoneal relations of the ducts are important. The gall-bladder and cystic duct are covered by peritoneum over the greater part of their surface, but there is a varying bare area on the side towards the liver and portal fissure. The hepatic ducts and upper third of the common bile-duct are clothed with peritoneum, but the lower two-thirds of the choledochus are retroperitoneal—a fact which we shall see has a rather important bearing on some cases. The lower end of the common duct is, in a considerable percentage of cases, embedded in the substance of the pancreas, but often it merely lies in a groove on its posterior aspect.

The structure of the gall-bladder and bile-ducts consists of a mucous membrane, a fibromuscular wall, and a peritoneal coat (*Fig.* 63). The muscular coat is not very thick, and, so far as my observation goes, seldom undergoes hypertrophy in order to overcome obstruction. In this it differs greatly from the musculature of the intestines and the ureters. Obstruction of the common bile-duct is generally accompanied by a dilatation and thinning of the wall of the duct above the obstruction.

The mucosa of the biliary tract is furnished with a large number of mucous glands. These glands are frequently large, and send their ramifications down to and—as Luschka[1] showed sixty years ago—sometimes *through* the muscular coat. I am told that the occurrence of these glandular acini under the serosa of the gall-bladder is well known to pathologists and is sometimes used to puzzle the student, who may naturally think that carcinoma is beginning; and yet I cannot find this anatomical point referred to in any English pathological or anatomical text-book, though it may be of some considerable pathological importance. (*See Fig.* 63.)

It is well to remember that the first and second parts of the duodenum contain chiefly bile, except for a short time after meals. The duodenum, liver, colon, and gall-bladder are in close relationship, and adhesions readily form which tend to limit extravasation.

Bile is secreted at low pressure, and though, if there be a lateral opening in one of the ducts, bile will escape, yet so long as there is no obstruction beyond the opening, the fluid tends to run in the correct channel and the unnatural opening tends to close. The surgery of the common bile-duct would otherwise be an unsatisfactory procedure, for it is a common operation to open the duct and leave it unsutured or only partly sutured. So long as a drain is put down to the duct it heals readily. No surprise should therefore be felt if an injury of the bile-ducts or gall-bladder should heal up fairly quickly and leave little trace of its exact position. Since this point has bearing on our subject, I will illustrate it by recounting a case which was under the care of my colleague, Professor Pannett, two years ago, and which he kindly gave me permission to mention.

Case 1.—John S., age 10, was knocked down by a motor-car which doubled him up and 'winded' him. He vomited a little blood. He was kept in bed for two days, then got about a little, but about twelve days after the accident there was a recurrence of abdominal pain and the abdomen became distended. When admitted to St. Mary's Hospital two weeks after the accident, his abdomen was distended, with general rigidity and tenderness. At operation, Professor Pannett found half a bucketful of fluid in the peritoneal cavity The fluid contained much bile. There was no rupture of the liver, but an *undetermined* lesion of the bile-duct in the region of the junction of the hepatic, cystic, and common bile-ducts. There was soft inflammatory infiltration in this region, and the exact site of the escape of bile was not detected. The gall-bladder was collapsed. The gall-bladder and the site of injury were drained, and a good recovery followed.

There are many similar instances published which show the natural tendency to closure of any rupture of the ducts. A certain amount of bile escapes, but a deposit of fibrin occurs and seals the opening. There is no difficulty in appreciating how, in many cases, extensive extravasation is prevented by three factors: (1) Low pressure of bile secretion and possible intermittency of the secretion; (2) Natural tendency to closure of the opening; (3) The readiness with which adhesions form to neighbouring viscera. This tendency to closure is not so well marked in the other muscular tubes.

Bile may be extravasated from any of its containing channels, and will pursue a different course according to the situation of the part from which it escapes. Since by far the greater surface of these channels is covered by peritoneum, it is to be expected that the majority of cases will show leakage

into the peritoneal cavity, and such is the fact. Yet there are a certain number of cases in which the bile finds its way chiefly into the retroperitoneal tissues. This may occur primarily from a part of the biliary tract which is uncovered by peritoneum, or secondarily by an intraperitoneal collection bursting through into the tissues behind the peritoneum. Amongst the total of 384 biliary fistulæ enumerated by Naunyn,[2] there were but 4 which were retroperitoneal. I do not doubt that others have seen such cases, but I

FIG. 63.—Section through the wall of a gall-bladder, clearly showing a mucous gland outside the muscularis mucosæ. (Kindly lent by Professor Newcomb.) (×37.)

have not been able to find any clinical account of such a condition in modern surgical literature. My two cases were as follows :—

Case 2.—Mrs. K. P., age 32, was taken with acute epigastric and right iliac pain at 8 a.m. on June 9, 1922. The epigastric pain ceased next day, but the iliac pain continued, and there was slight pain on micturition, and also over the front of the right clavicle on breathing.

When I examined her at St. Mary's Hospital on June 10 there were tenderness and an indefinite swelling in the right loin, where the muscles were rigid. There was not so much tenderness in the right iliac fossa. There was pin-stroke hyperæsthesia above the outer part of the right Poupart's ligament and the anterior part of the right iliac crest. At 10 p.m. on the 10th I operated by a right paramedian incision. The appendix was normal, but free bile was discovered in the peritoneal cavity. There was fibrinous lymph under the liver, and some lymph in front of the liver (accounting for the clavicular pain), and an infiltration with bile of the posterior parietal

peritoneum, which was of maximal intensity just to the right of the descending duodenum in front of the renal pelvis. There were no gall-stones, and I found no perforation of the gall-bladder or bile-ducts. As I wiped the posterior peritoneum dry it almost immediately wept bile once more, though I could see no opening in the peritoneum.

I drained the gall-bladder and the subhepatic pouch, and an uninterrupted recovery took place.

The noteworthy points in this case are the absence of jaundice, the possibility of localizing the lesion by the anatomical symptoms, and the failure

FIG. 64.—Section through the lower end of the common bile-duct, showing the absence of the muscularis mucosæ in one place and demonstrating the deep penetration of the mucous glands. (Section kindly cut for me by Professor Newcomb.) (× 37.)

to find a perforation which presumably must have existed behind the peritoneum. Such a favourable termination was lacking in the second case, which was nevertheless in many ways more remarkable.

Case 3.—Mrs. A., age 50, was admitted to the Bolingbroke Hospital on May 27, 1921, with a history that forty-eight hours previously she had been taken with abdominal pain—first epigastric, then right iliac. She vomited. When I saw her soon after admission I noted that she was a very stout woman, and that there was a fomentation scald in the right iliac region, where there were tenderness and muscular rigidity. Pin-stroke hyperæsthesia was noted as a band about 2 in. broad above Poupart's ligament and the iliac crest on the right side as far back as the outer margin of the erector spinæ muscle. There was pain on extension of the thigh.

Appendicitis was diagnosed, and the abdomen opened by a right-iliac-oblique incision. No sign of recent appendix inflammation was noted, however, but the tip of the organ was discovered separate from the rest—clearly from old perforative inflammation.

The most noteworthy observation was œdema of the posterior parietal peritoneum and retroperitoneal tissues. On incising the posterior peritoneum we found extensive extravasation of bile into the retroperitoneal tissues round the right kidney, duodenum, and down to the right iliac fossa ; the bile was green, and glittered with innumerable cholesterin crystals. The incision was then prolonged upwards, and a stone found in and removed from the gall-bladder. No perforation was found, but there were omental adhesions, and it was difficult to explore thoroughly. There was no bile in the peritoneal cavity. Drainage down to the gall-bladder and retroperitoneal tissues was carried out.

The patient died ten days later, but no autopsy was obtained.

These two cases well illustrate mild and severe forms of retroperitoneal extravasation, and for their causation one must assume a leakage from the retroperitoneal surface of the gall-bladder or common bile-duct. Such leakage causes irritation of the pelvis of the kidney and the upper end of the psoas, whilst there is likely to be hyperæsthesia of the twelfth dorsal segmental area.

Intraperitoneal extravasation of bile is more common, and can be caused by injury or disease of the gall-bladder, bile-ducts, or duodenum. There is no doubt as to the immediate cause of the extravasation in some cases. Penetrating or subcutaneous injury of the biliary tract leaves little room for doubt, for, even though at operation the actual site of rupture may be difficult to detect, the connection with the injury is usually too consecutive to be other than consequential. Perforation of the gall-bladder due to gangrene or ulceration may also lead to extravasation, but the leakage is generally localized to the right hypochondrium by limiting adhesions.

Sometimes the fluid which escapes from the duodenum on perforation of an ulcer appears to be almost pure bile, and may cause a suspicion of rupture of the biliary tract. Pure bile appears to cause less peritoneal irritation than the ordinary fluid which escapes after perforation of a duodenal ulcer, and the symptoms may be less brusque in onset. The afore-mentioned causes are clear, and there is little need to furnish illustrative cases, though such could easily be afforded. There remains, however, a considerable group of cases in which there is a plentiful biliary extravasation, but neither at operation nor at autopsy (if such takes place) can any perforation of the biliary tract be discovered. This condition has aroused discussion, chiefly in Germany, where exhaustive and exhausting treatises have been written, with rather inconclusive results. During the past few years I have had six such cases under my care. To these I will add another patient upon whom my colleague, Mr. Bryan, operated.

SYNOPSIS OF CASES.

Case 4.—M. H., age 55, female, was seen by a colleague on Aug. 23, 1920, suffering from agonizing abdominal pain and vomiting.

Condition.—Aug. 23 : Pale, shivering, and in great pain. Legs drawn up. Respiration 30, pulse 100, temperature 102°. Slight jaundice. Slight epigastric rigidity. On Aug. 24 there was distention, which was increased next day, when the pulse was 118, respiration 30, and pain was less. I was then asked to see her and decided to operate.

OPERATION.—Subumbilical incision: inflamed intestines found. Epigastric incision: free bile in peritoneum. Gall-bladder adherent to duodenum. No stone found. Gall-bladder aspirated and drained. Drainage also of pelvis and gall-bladder recess.

RESULT.—Recovery.

Case 5.—Female, age 60. In September, 1921, the patient had abdominal pain, first generalized, then localized to right hypochondrium.

DIAGNOSIS.—Acute cholecystitis.

OPERATION.—Abdomen full of green fluid. Lymph round first part of duodenum, but no perforation found. Drainage suprapubic and gall-bladder pouch.

RESULT.—Died.

Case 6 (*Fig.* 65).—C. M., age 55, male. A history of jaundice for three weeks; on the morning of June 28, 1922, there was an acute onset of abdominal pain and distention.

FIG. 65.—Biliary tract in *Case* 6. Common duct larger than gall-bladder; it contained 40 stones, some as large as a hazel nut. No perforation found. (×⅔.)

CONDITION.—June 28: Distended; much free fluid in abdomen; tender right lumbar region; very large liver; cardiac murmurs. On the next day there were hæmatemesis and hiccough.

RESULT.—Died. (No operation performed.)

POST-MORTEM.—General peritonitis. Bilious purulent exudate; no perforation found; common duct enormously dilated, with many stones; healed tubercle both lungs; aortitis and small saccular aneurysm; hydatid cyst of right kidney; adherent pericardium; patent foramen ovale; tape-worm.

Case 7.—Female, age 79, was seen on Aug. 20, 1923, with a history of six days' abdominal pain; acute onset, then remission, and exacerbation.

CONDITION.—Signs of general peritonitis. Distended abdomen; congestion of lungs; weak heart action. (Consultation with a physician.)

OPERATION.—Free bile in peritoneal cavity, especially in right hypochondrium. Lymph over ascending colon; no perforation found; drainage of peritoneal cavity only

RESULT.—Died same day. (No autopsy.)

Case 8.—Female, of middle age, seen on Nov. 19, 1923, had a history of indigestion for years, sometimes with jaundice; attack of abdominal pain on Nov. 10. There was a remission of symptoms, but she became worse again on the 17th, with frequent vomiting, and pain on top of shoulder.

CONDITION.—Nov. 19: Abdominal facies; looked moribund. Pulse 108, almost imperceptible. Abdomen tumid and tender all over.

DIAGNOSIS.—Ruptured gall-bladder or duodenum.

OPERATION.—Right paramedian incision: bile in peritoneal cavity; no perforation of duodenum; dense mass of adhesions in biliary recess. No gall-stones felt, but gall-bladder impossible to identify. Drainage of biliary recess and of pelvis.

RESULT.—Against expectation the patient improved, and left the nursing home in a month. Soon after had acute attack of abdominal pain, and succumbed.

Case 9.—S. H., female, age 55. When seen on April 5, 1924, had had five weeks' abdominal pain, with vomiting, sweating, and attacks of faintness for one week.

CONDITION.—Subnormal temperature; distended abdomen; pulse normal.

DIAGNOSIS.—Intestinal obstruction.

OPERATION.—On opening abdomen, bile welled up; large liver and gall-bladder. Three-quarters of a pint of bile aspirated from gall-bladder; two gall-stones removed from gall-bladder. No perforation of duodenum or bile passage discovered. Gall-bladder and peritoneal cavity drained.

RESULT.—Died within twenty-four hours. (No autopsy.)

Case 10 (*Mr. Bryan's case*).—Male, age 26. History of flatulence for some weeks. At 5 a.m. on June 14, 1913, patient had acute right hypochondriac pain going through to lumbar region; vomited. There was a history of a similar attack six months before; never jaundiced.

CONDITION.—Pulse 104, temperature 101°. Slightly rigid and tender right hypochondrium; chest nil; rectal examination negative; no jaundice. June 15: slight jaundice. Collapsed in afternoon and became distended.

OPERATION.—Acutely distended pink gall-bladder. Golden bile staining of portal fissure region before gall-bladder opened. No perforation found; no stone found. Gall-bladder aspirated and drained. No peritonitis.

RESULT.—Recovered.

In none of these cases was any definite perforation found. It will thus be seen that the clinical symptoms of intraperitoneal extravasation of bile are very variable. The picture is that of an acute or subacute peritonitis originating in the right upper quadrant of the abdomen. The onset may be acute or gradual; jaundice may be present or absent; gall-stones may be found in the gall-bladder and ducts, or the biliary passages may contain nothing but bile; there may be a subnormal, normal, or elevated temperature; and abdominal tenderness, rigidity, and distention vary greatly in degree. In the midst of this variability there is one feature which is almost constant, i.e., the remission of symptoms after the first acute onset. Remission of symptoms is unfortunately a common occurrence in many acute abdominal disorders, but perhaps in none is it so marked and dangerous as in extravasation of bile. Omental adhesions form, and for the time easily stop the progress of the bile, which is under low pressure; the patient and doctor think more lightly of the condition, undue liberty and exercise are allowed, and extension of the disease occurs. Only thus can we account for the advanced stage of the disease in several of the cases under review. Clearly the remedy is to consider every case of right hypochondriac peritonitis as dangerous.

CAUSES OF BILE LEAKAGE.

We will now consider the view held in different quarters as to the reason for the leakage of bile in these obscure cases.

The first discussion and experimental work on the question was published in 1911 by Clairmont and Haberer.[3] Their interest was aroused by finding free bile in the peritoneal cavity of a man who had stones in the cystic and common duct, but in whom no perforation was found in the biliary tract either at operation or at autopsy. Their experiments seemed to show that ligature of the common duct in dogs would cause exudation of bile into the peritoneal cavity without perforation of the biliary tract. They explained the leakage as a filtration through the walls of the gall-bladder or ducts. They assumed " a pathological process of the biliary passages not microscopically demonstrable " which permitted the filtration.

Following the researches a host of eager observers and disputants entered the field. The filtration theory was supported by Schievelbein,[4] who thought the channels of Luschka's glands a likely site for leakage; but opposition came from many who thought it more likely that a minute perforation could be overlooked. The suggestion was put forward by Wolff[5] that there might be leakage from the intrahepatic canals on the under surface of the liver, whilst Johansson[6] theorized as to a possible hypertrophy of the lymphatic canals.

The filtration theory was criticized in 1921 by Ritter,[7] who remarked that " the objection that though none be found there can yet be some perforation must be reckoned with "; and again, " only very careful macroscopic and microscopic examination can give proof as to whether perforation existed or not ".

Burchardt[8] in 1923, in an elaborate article, came to the conclusion that " the occurrence of an authentic biliary extravasation or biliary peritonitis without perforation is not yet proved "; and that " a more plausible view than the filtration theory is the suggestion that the perforation opening was not found or was already healed ". My own observations lead me to agree with this suggestion. It would be altogether contrary to our knowledge of involuntary muscular tubes to allow that they would permit filtration of their contents even when seriously damaged, so long as there was no perforation. Much more likely is it that there is a minute perforation which allows escape of bile when under tension. After the escape of sufficient bile to relieve tension the opening may be sealed off by lymph, so that no more fluid enters the peritoneal cavity. This process may occur from time to time until the symptoms are so serious that surgical interference becomes imperative. The minute perforation is sometimes in the gall-bladder, but undoubtedly sometimes in the ducts, since in several cases the gall-bladder was tensely distended but not leaking. The nature of the pathological process which causes the minute perforation must be presumed to be a small area of infective or traumatic ulceration of the mucosa. The biliary tract is very prone to infection, and is liable to trauma of a special type, i.e., that caused by a passing stone. It is needless, and indeed impossible, to invoke a gall-stone

as the only cause of injury to the ducts, for in many cases no stones are found and no definite history of colic is given; but that it is a possible and even likely cause in some cases I have no doubt. On one occasion when I opened a man who showed signs of right hypochondriac peritonitis, and who gave a perfectly typical history of biliary colic with sweating and writhing for several hours, I found no perforation of the duodenum or gall-bladder, but much lymph round those viscera, and a much thickened right free edge of the gastrohepatic omentum, with some green bile showing under the peritoneal covering of that structure immediately over the position of the common duct. Though no gall-stone was found or obtained from the fæces, I believe that a stone had passed, had stretched the common duct, and allowed slight leakage of bile. It is a tempting hypothesis to assume that the glands of Luschka provide a ready channel for spread of bacterial infection and for leakage of bile. (*See Figs.* 63 and 64.)

There is no clinical doubt that the peritoneum is the strongest safeguard against intraperitoneal extravasation. If there is ulceration within the bile-ducts, no leakage is likely to occur into the peritoneal cavity until the peritoneum itself is damaged. It is not uncommon to see a very tensely distended gall-bladder with severe ulceration of the mucosa, but a fairly healthy silvery-white peritoneal covering which allows no leakage.

The Differential Diagnosis has to be made from the other causes of spreading peritonitis originating in the right side of the abdomen. The chief conditions are: cholecystitis, perforation of a duodenal or pyloric ulcer, appendicitis, acute or subacute pancreatitis.

In the late stages, when there is an extensive peritonitis, one cannot exclude intestinal obstruction except by considering very carefully the previous history. In cases of appendicitis and perforated ulcer the history is usually sufficient to guide to a correct diagnosis. I see no way of differentiating many cases of cholecystitis and pancreatitis from the results of a leakage of bile.

So great is the difficulty in diagnosis that Ritter in 1921 stated that the correct diagnosis of biliary peritonitis had never been made before operation. That statement needs some modification, for it was in August, 1920, that I diagnosed one of my cases as peritonitis from a ruptured gall-bladder and found biliary peritonitis at operation. On referring to the symptoms in this case it will be found there were slight jaundice and a history of epigastric pain and increasing symptoms of peritonitis to guide me. In my other cases I made incorrect diagnoses. I think in the future diagnosis may possibly be helped by finding bile in the blood.

Treatment.—The treatment of biliary extravasation is by operative measures. The bile must be allowed to escape from the peritoneal cavity so far as is possible, and any tension in the biliary passages must be reduced. In a patient who is very ill, merely drainage of the peritoneum and of the gall-bladder is called for.

If the biliary ducts appear normal and the bile appears to be escaping from the gall-bladder, it is a natural procedure to remove the gall-bladder,

provided the patient's condition warrants it. Any stones in the common duct should be removed.

With the present late-coming of these cases, however, the mortality is very great. Six out of ten of the cases mentioned in this paper succumbed. It is quite clear that the curing of acute abdominal disease depends chiefly upon early diagnosis.

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CARCINOMA OF THE VERMIFORM APPENDIX.

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An interesting primary tumour of the vermiform appendix is met with occasionally by the pathologist. It occurs usually as a small round yellowish growth situated, in nearly all cases, at the distal end of the organ. Microscopically the tumour is found to consist of colonies of rounded cells lying in well-marked alveoli, and often seen invading the muscular wall. In some specimens the cells actually reach the peritoneum. In addition to the round cells there are also present columnar cells which are arranged in a ring-like manner. These cells vary in number in different specimens, usually scanty, but they may be quite numerous. Vacuolation of the cell bodies is common.

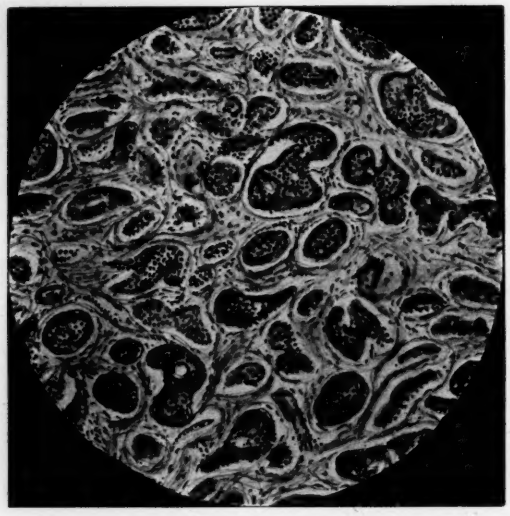

Fig. 66.—*Case* 1. Colonies of cells in alveoli. Note ring of nuclei around many of the masses suggesting immature columnar cells, and vacuolation in the midst of some groups. Matrix composed of fibrous tissus. Low-power view. (⅔ obj., No. 4 eyepiece.)

Like other observers I have been at a loss to account for the origin of these cells. What particular kind of cell in the wall of the appendix could one look upon as being the parent cell?

In writing my reports on these tumours, I have been obliged to state that the cells of the growth have the general arrangement and infiltrating character of carcinoma, and to modify this by adding that the clinical course of the growth is usually that of an innocent tumour—clearly an unsatisfactory state of affairs both for the pathologist and clinician.

The problem as to the true nature of the tumour has led to much investigation and speculation by pathologists, the points of interest and importance being: the origin and type of cell giving rise to the tumour; and, Is it innocent or malignant in its clinical behaviour?

Some pathologists have labelled this variety of tumour by that much-abused term endothelioma, a name under which so many tumours are classed when the pathologist is in doubt whether he is dealing with a carcinoma or sarcoma. I have always been at pains to avoid using this term, and sought every avenue of escape from it. In spite of this dislike of the term, I have fallen to the temptation and used it occasionally in a fit of desperation and

as an easy way out of a difficulty. There can be no doubt that endothelial cells do proliferate like all other cells of the body and give rise to tumours, but I could never see any real justification for labelling these primary tumours of the appendix with the term endothelioma. Endothelial cells are oval or spindle in shape. The appendix-tumour cells are round and columnar.

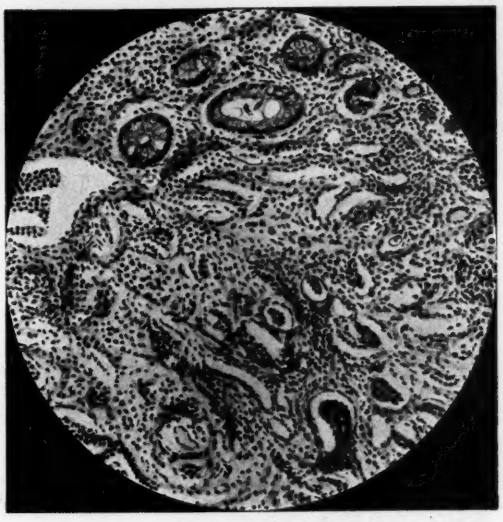

FIG. 67.—*Case* 1. Edge of same growth. showing small round-celled infiltration and several Lieberkuhn's glands in the upper part of the field. The mucous membrane is invaded and partly destroyed at this spot. (Same magnification.)

After my last specimen was received and reported on in the usual way, I began to ponder over these growths again, and to wonder whether I could discover anything definite as to their real origin and nature. The important point of after-history of the patients from whom the tumours were removed seemed a valuable one to investigate. I went through my private records and those in the Pathological Department at the Royal Northern Hospital: the list of cases, with all available and relevant details, is given in the following pages.

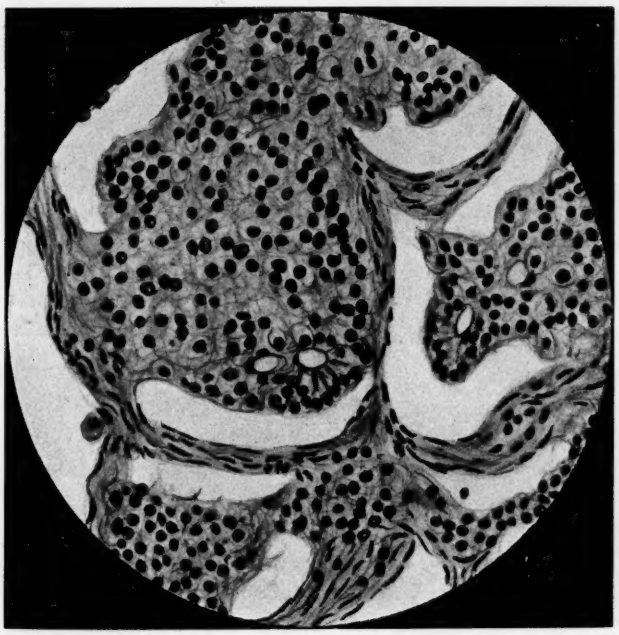

FIG. 68.—*Case* 1. Several large groups of cells showing vacuolation and an attempt at tubular formation. The cell masses have shrunken away from the alveolar walls during the process of preparation of the section. High power. ($\frac{1}{6}$ obj., No. 4 eyepiece.)

The outstanding feature revealed in the clinical data is the presence in almost every case of symptoms pointing to some trouble in the region of the appendix. In some cases there is evidence in the specimens of coincident inflammatory changes, while in others the appendix was normal apart from the presence of a tumour. In regard to the latter group it is perhaps permissible to advance the theory of interrupted or irregular peristalsis of the appendix due to the presence of a tumour as a cause of the symptoms.

All the specimens exhibited some kind of swelling or tumour. In several it was not possible to tell by naked-eye inspection whether the swelling was due to simple fibrous hypertrophy with obliteration of the lumen—a common condition accompanying chronic appendicitis—or to a new growth. In others the yellowish colour of the tumour prompted the inquiry as to the possibility of tuberculous disease being present. The only specimen in my series in which a tumour was present in the body of the appendix was one apparently composed of two nodules (*see Case* 9). They were lying side by side, and had ulcerated on the inner surface.

In an effort to elucidate the nature and origin of the tumour cells, I studied closely all the microscopic sections in my possession, and found there was a striking similarity in the type of cell present in all the specimens, and also in the arrangement of the cell masses. As stated above, the cells are mostly round in shape, and some of them are rather large; they lie in well-defined alveoli. The nucleus is small and round. The number of cells in the alveoli varies from half a dozen or so to a hundred or more, and they are usually packed closely together. The alveolar walls are composed of well-marked fibrous tissue in the main tumour, but where the cells have invaded the wall of the appendix, the muscular tissue of that structure forms the boundaries of the alveoli.

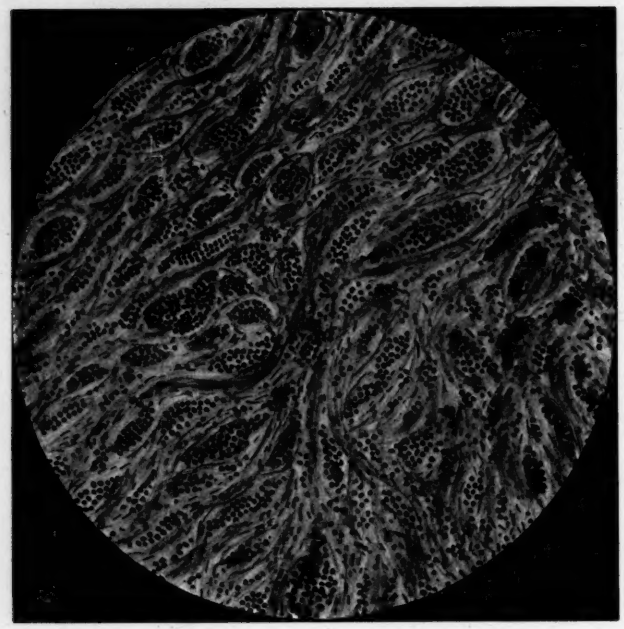

FIG. 69.—*Case* 3. Illustrating the general alveolar distribution of the tumour cells, which in this field are all about the same size and round in shape. Low power. (⅔ obj., No. 4 eyepiece.)

These tumour-cells are quite unlike those lining the mucous membrane, which are tall and columnar in shape. What, then, is the parent cell? The only large round cells met with in the normal appendix are those composing the sympathetic ganglia and the island cells in the lymph nodules. The question arises: Are either of the latter the parent cells of the new growth? Against this theory of origin is the fact that these two varieties of cell belong to the connective-tissue group, and cellular tumours of connective-tissue origin are composed of cells glued together, as it were, by an interstitial substance, and not distributed as groups or colonies lying loosely in alveoli such as occurs in tumours derived from epithelium.

The alveolar distribution of the cells in the appendix tumours is so striking that I felt convinced that the cells must be of epithelial origin. The

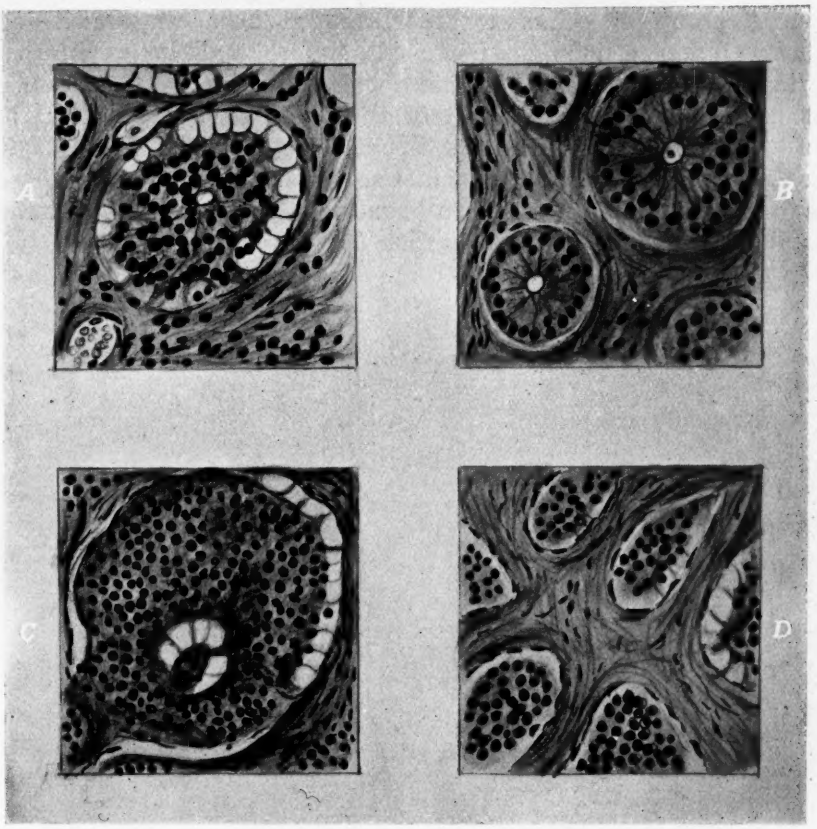

FIG. 70.—*Case* 3. Four small fields selected to show the variation in type of cells. In (*A*) and (*C*) vacuolation of the cells is well marked, and there is a tiny central lumen in (*A*). (*B*) Shows two well-formed tubules in cross-section. (*D*) mainly composed of rounded cells closely packed. High power. ($\frac{1}{6}$ obj., No. 4 eyepiece.)

presence of columnar cells in parts of the tumours strengthened this opinion. I was also struck by the close resemblance of the microscopic pictures to those

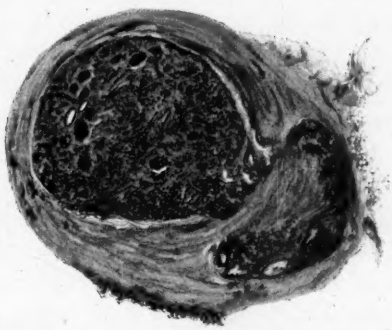

FIG. 71.—*Case* 3. Main growth well defined within the muscular wall. Below on the right it has penetrated the wall and forms a secondary smaller mass. Outlying deposits of tumour cells are indicated in the muscle and peritoneum by tiny black dots. (× 4.)

of many breast carcinomata. In most of the latter the predominant cell is round (spheroidal), but a varying number of cubical and columnar cells are

generally seen in some parts of the sections. Following this line of thought while examining the sections of the appendix tumours, I began to appreciate more fully the significance of the columnar cells, which were seen in varying number. A group of columnar cells arranged in a ring, with the clear protoplasm of each cell on the inner side and a small lumen in the centre of the ring, demonstrated well an attempt at tubular gland formation. These rings of cells may lie in the midst of the round cells which form the great bulk of the tumour, or be present in small alveoli of their own. Quite a number of such rings were found in one specimen. In another slide two rows of columnar cells with a space between the columns clearly indicated a tubular gland cut in longitudinal section (*see Fig.* 76).

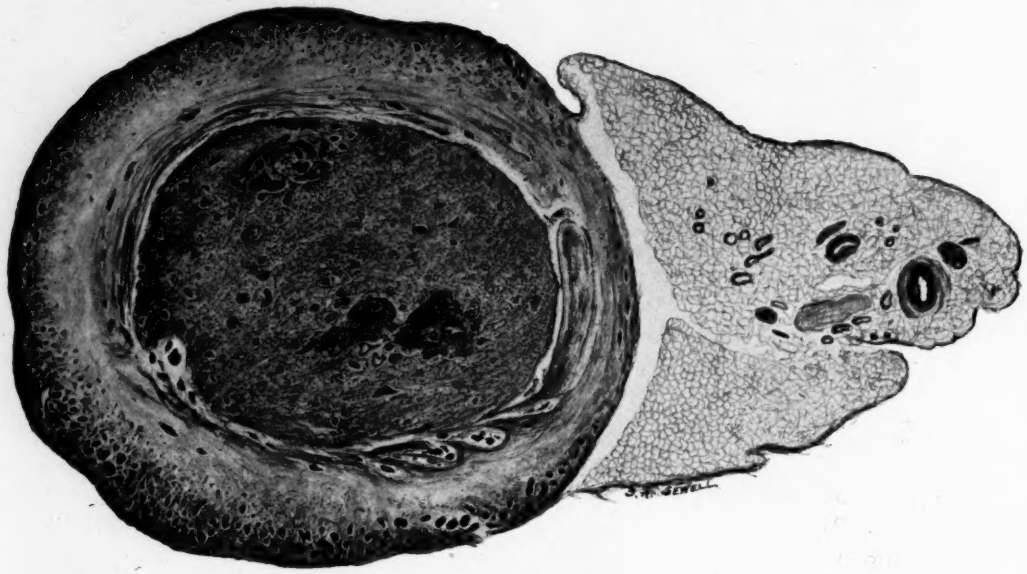

FIG. 72.—*Case* 5. Similar location of main tumour within the appendix ; it is unusually fibrous and contains numerous blood-vessels. Offshoots of tumour cells are seen invading the muscular wall, and a wide area of small colonies is seen in the outer layers of muscle and in the peritoneum. The middle portion of the muscle is practically free from growth. (about × 12.)

Before accepting the theory of epithelial origin of the appendix tumours it will be necessary to explain the presence of the round cells in such predominant numbers. Can it be proved that these cells are epithelial in origin ? Do they arise from the same type of cell as do the columnar cells ? If so, why are they round and not columnar in shape ? I think a satisfactory answer to this question is to be obtained by comparison with the composition of carcinoma of the breast and other parts of the body. As referred to above, most cases of carcinoma of the breast show columnar cells in addition to the predominant spheroidal cell. The same mixture of cells occurs in some specimens of nasal and antral carcinomata. It is also seen in the stomach. It appears therefore that while some cells attain their typical columnar form in the appendix tumour, the main bulk of them have not advanced in development beyond their primitive circular shape.

If we accept this theory of origin from columnar epithelium, how can we explain the striking difference between the ordinary intestinal growths with their multitudes of typical columnar-celled glands and the tumours of the appendix under review?

I venture the opinion that, whereas the former growths undoubtedly arise from the surface layer of tall columnar cells, the appendix tumours originate from deep-seated epithelial cells which have been cut off in the early stage of fœtal life. This is, of course, in conformity with Cohnheim's theory of 'latent embryonic rudiments' being a source of origin for certain tumours. I feel sure that this explanation must be the correct one.

It may be asked why, if a few columnar cells are separated in the course of development, they do not grow into well-marked columnar cells in a subsequent tumour? The answer to this question is simple. In very early fœtal life all the cells are round in shape; this is the basic type, and from it spring all the higher forms during the development of the compound organism. Failure to form typical columnar cells from a rudimentary deposit of parent cells shows a weakness in developmental power. The cells may multiply, but, with the exception of a few which reach the columnar stage, they seem incapable of attaining the higher type. This weakness in the power of full development of cells is seen in most specimens of carcinoma—a typical columnar-celled growth usually contains many round epithelial cells.

From the evidence given above, I feel justified in asserting that this particular variety of primary tumour of the appendix belongs to the epithelial group.

Another interesting feature of these tumours is the variability in the number and distribution of small round inflammatory cells. In many fields under the microscope there is an entire absence of these little cells, and in others a few are seen. In several specimens they are numerous.

A feasible explanation for this variation is that the tumour is at first deep-seated and well away from the lumen of the appendix, thus well shut off from septic infection. As it enlarges, the mucous membrane is pushed away and stretched over it. The thinned membrane is in this way damaged, and infection by micro-organisms from the gut takes place. Small round-celled invasion then occurs in the usual manner. A coincident attack of appendicitis is another cause.

The next problem that confronts the pathologist is: Is the tumour innocent or malignant? Is it to be labelled adenoma or carcinoma? First of all, let us review the accepted characteristics of these two main groups.

Carcinoma:

a. Groups of epithelial cells lying in alveoli.
b. Cells invade and destroy the tissues of the organ.
c. Cells invade the surrounding tissues.
d. Form secondary growths in lymphatic glands and distant organs and tissues.

Adenoma:

a. Groups of cells imitate structure of gland from which they arise. The tumour may press upon and injure adjoining tissues, but the cells do not behave in the manner described under (*b*), (*c*), (*d*).

It will be seen that the appendix tumour cells as demonstrated in my series behave in the manner described as (*a*) and (*b*). The disappointing results of inquiries into the after-histories of my cases throws very little light on the points (*c*) and (*d*).

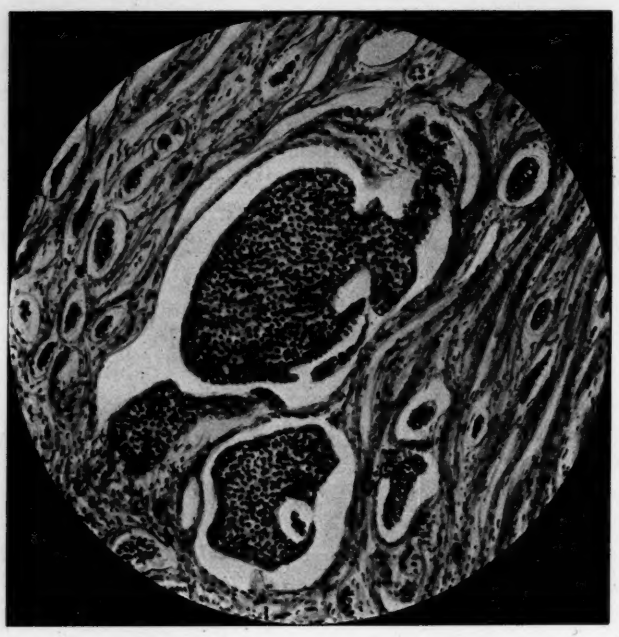

FIG. 73.—*Case* 6. Several large collections and numerous small colonies of cells in alveoli with fibrous walls. ($\frac{2}{3}$ obj., No. 4 eyepiece.)

At this stage of my labours it seemed very doubtful whether it would be possible to come to any definite conclusion as to the innocent or malignant nature of these tumours—tumours so malignant in microscopic structure, yet apparently innocent in clinical behaviour. My own series had failed to prove anything clinically. Then quite unexpectedly a very important piece of evidence was obtained. A microscopic section of secondary growths in the liver was shown at the Medical Society of London by the President, Dr. Eustace M. Callender. The primary tumour was found in the appendix. Dr. Callender has kindly placed the section and clinical notes of the case at my disposal, and it has such an important bearing on the subject of this inquiry that I feel justified in giving full particulars.

Dr. Callender's Case. — Widow, age 53. The patient had an attack of rheumatic fever when 10 years old, followed by 'slight lesion of the heart'. She was always 'too red'. For the past two years attacks of diarrhœa accompanied with abdominal pain occurred. Latterly these attacks became more frequent, and were accompanied by retching and vomiting. On Nov. 15, 1923, she was first seen by Dr. Callender, who found her well nourished, with plenty of subcutaneous fat, profoundly cyanosed

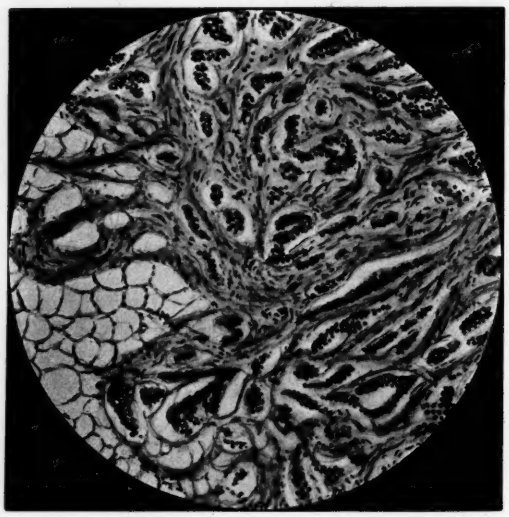

FIG. 74.—*Case* 6. Colonies of rounded cells in alveoli the walls of which are composed of unstriped muscle. The growth is also invading the subperitoneal fat. (Same magnification.)

and almost pulseless. The abdomen was universally tender, particularly the upper part and right iliac fossa. The patient improved slightly under treatment, but died suddenly on Nov. 18, while sitting up in bed.

Post-mortem examination revealed 'atheroma of coronary arteries and mitral valve'. The liver was much enlarged and filled with malignant growths. The appendix was enlarged to the size of a 'small Tangerine orange' by the presence of a yellowish-white solid growth. The growth had not spread beyond the appendix.

The blood examination showed a marked condition of polycythæmia.

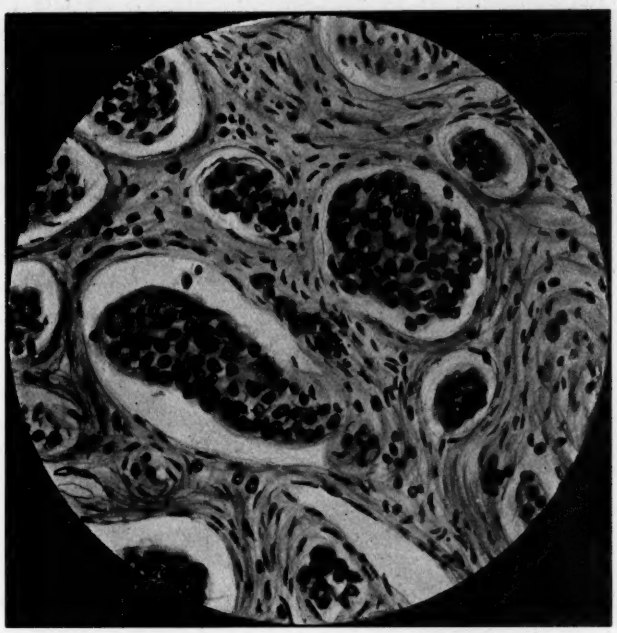

FIG. 75.—*Case* 6. Colonies of rounded cells closely packed and separated by fibrous bands. ($\frac{1}{6}$ obj., No. 4 eyepiece.)

Microscopic examination of the liver shows masses of cells contained within well-formed alveoli with fibrous walls. Some collections are small and others very large. Necrosis of some of the large areas has occurred and hæmorrhage has taken place into some of the cell masses. Most of the cells are round in shape and of medium size: the nucleus is small and round. Here and there columnar cells can be seen arranged in imperfect rings and surrounding a small central space (lumen). (*See Figs.* 77, 78, 79.) A comparison of this picture with those presented by the appendix tumours described above shows them to be identical. There is no room for doubt that we are looking at a secondary deposit of carcinoma in the liver which has originated as one of those curious and mysterious primary tumours of the appendix.

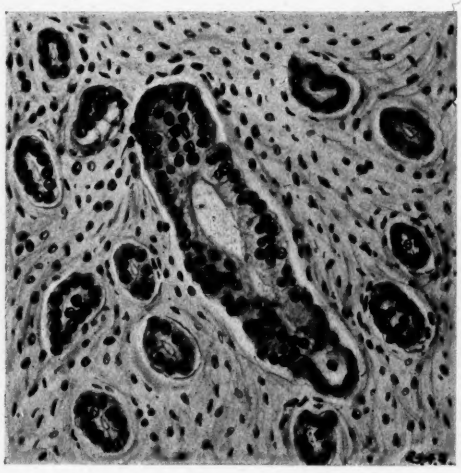

FIG. 76.—*Case* 6. Note marked tubule in longitudinal section and other tubules in cross-section. The columnar shape of some cells is well shown. (Same magnification.)

Unfortunately sections of the appendix growth are not available; but in spite of this, it is only necessary to compare the drawings made from the liver growth with those of others from the appendix tumours to make us feel

certain that we are looking at identical growths. Assuming then, from the above evidence, that one of these primary appendix tumours has proved to have given rise to metastatic deposits in the liver, then the vexed question as to whether they are innocent or malignant must be answered—They are malignant. Further, from the fact that columnar epithelial cells are found in the growths we can definitely place the tumour in the carcinoma group.

The indefinite place which these little tumours have in medical literature, and the uncertainty which exists in the mind of the various authors, is well illustrated in the abstracts quoted below. This uncertainty is due to several causes. In the first place, the tumours are rare, and their discovery in the abdomen may be looked upon as accidental in practically all cases. Again, they appear to be of slow growth; and so, after removal with the appendix, the later history of the cases is lost owing to the well-known difficulty of keeping in touch with patients after operation. If some means could be devised to make complete records of the patients' lives after removal of the appendix, some estimate could be made as to what percentage, if any, recurred and destroyed life. I imagine very few cases do recur, for in a long experience of post-mortem work I have not seen one. The establishment of a National Museum of Pathology, which I have been advocating during the past two years, would take such a task in hand.

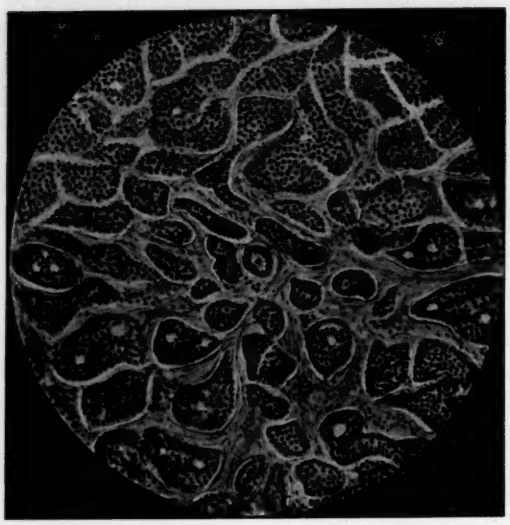

FIG. 77.—*Dr. Callender's case of secondary growth in the liver.* The type of cell and general alveolar arrangement of the growth is strikingly like that seen in *Fig.* 66. There is a small ring of columnar cells in the centre. ($\frac{2}{3}$ obj., No. 4 eye-piece.)

It has not been possible to count all the appendices that have passed through my hands during the past twenty years, but as a matter of interest the figures at the Royal Northern Hospital for two years in which they were examined for another purpose are worth quoting. For the year 1922, 280 appendices were removed by operation, and 209 for the year 1923. These figures are much higher than those of ten or more years ago, but they serve to indicate the rarity of this variety of carcinoma.

LIST OF CASES.

The following cases are enumerated in chronological order, and are accompanied with such data as were available or considered pertinent to each. Of these cases, five were treated at the Royal Northern Hospital, and six occurred privately.

I wish to thank those gentlemen who have given me permission to use

their cases, and for the trouble they have taken in looking up old records and writing to the patients' medical advisers to obtain later information to make the cases complete. I also wish to thank my friend Dr. W. H. McKinstry for his kindness in looking through the medical literature, and Mr. S. A. Sewell for his excellent drawings.

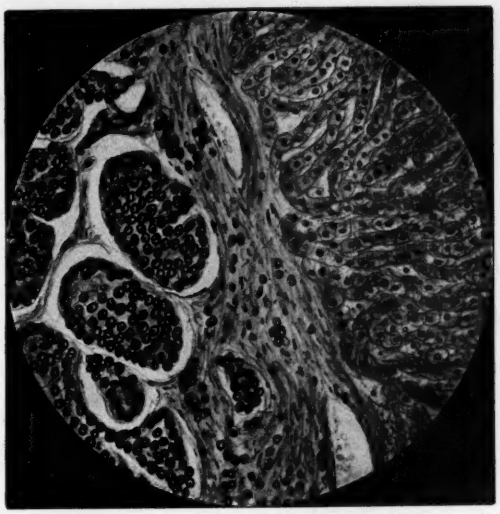

FIG. 78.—*Dr. Callender's case.* Includes a portion of liver tissue on the right. ($\frac{1}{6}$ obj., No. 2 eyepiece.)

Case 1.—(*Figs.* 66, 67, 68). May 25, 1904. Male, age 19. (Mr. McAdam Eccles.) Symptoms pointed to some lesion in the region of the appendix, and it was removed.

A small caseating tumour was found in the tip of the appendix. Slight fibrous adhesions were present on the outer surface of the organ.

The patient was last seen two years after the operation and was then quite well.

Case 2.—June 21, 1906. Male, age 29. (Mr. Mower White.) The patient had suffered with pain after food for five years. Latterly the pain was continuous. On examination a sausage-shaped tender swelling which could be 'rolled' under the fingers was detected through the abdominal wall. The appendix was removed by operation, and a small bulbous swelling found at the distal extremity. No after-history could be obtained.

FIG. 79.—*Dr. Callender's case.* Shows large irregular tubules of columnar cells. The other cells are closely packed and of indefinite shape. The reticulation in the tubules represents extravasated blood. ($\frac{1}{6}$ obj., No. 4 eyepiece.)

Case 3.—(*Figs.* 69, 70, 71). Sept. 23, 1909. Male, age 59. (Mr. Mower White.) Some time before, the patient had suffered from an abscess about the duodenum. Latterly symptoms of appendicitis developed, and an operation was performed for removal of the organ.

The appendix is short and thick, and its surface covered with old fibrous adhesions. The distal end is rounded off, and on section found to contain a mass of solid growth. The muscular wall can be traced all round the tumour. (*See Fig.* 71).

No after-history was obtainable.

Case 4.—Sept. 12, 1913. Mr. W., age about 35. (Mr. Mower White.) Patient had recently returned from America, where a diagnosis of appendicitis had been made. More recently he had what appeared to be a slight attack of appendicitis, and an operation was decided upon.

The appendix shows a slightly nodular mass at the tip and the peritoneal surface is smooth.

The doctor in charge reports that he has quite lost sight of the patient.

Case 5.—June 18, 1914. Miss E. W., age 38. (Mr. Mower White.) History of increasing abdominal discomfort for two years. Pain in right side and back lasting a few hours. Slight tenderness over McBurney's point. Nothing else found.

Bulbous swelling near tip of appendix. Solid yellow material in centre of swelling. (*See Fig.* 72.)

No after-history was obtained.

Case 6.—(*Figs.* 73–6.) Oct. 7, 1914. Spinster, age about 50. (Mr. Mower White.) Patient had an attack of abdominal pain, with tenderness and swelling in the right iliac region. There was some doubt as to the diagnosis of appendicitis, and a few high enemata were given. At the time of the operation there was no evidence of peritonitis, and the cæcum was empty.

Large yellow caseating mass at tip of appendix.

Patient died five years later from nephritis. There was no clinical evidence of new growth. No post-mortem examination was made.

Case 7.—April 3, 1917. Mrs. M. A., age 54. (Mr. Barrington-Ward.) An abdominal tumour was noticed for six months, accompanied with flatulence, constipation, and frequency of micturition. At the operation a multilocular ovarian cyst was found, and removed together with the appendix.

Appendix acutely inflamed, and its distal end is occupied by a small solid firm mass.

A letter of inquiry was returned through the post.

Case 8.—Nov. 19, 1919. Female, age 25. (Dr. D. R.) Operation performed for appendicitis. Appendix enlarged, and its distal extremity is occupied by a solid bulbous mass.

No further record obtainable.

Case 9.—March 7, 1923. S. F., female, age 11. (Mr. Mower White.) The patient was brought up to London by ambulance from a boarding school, where she had developed what appeared to be a subacute attack of appendicitis. On arrival in London there was a tender swelling in the right iliac fossa. The appendix was removed the following day. It showed evidence of recent inflammation, and there was definite evidence of local peritonitis.

Appendix about 2 in. long; wall very thick and covered with slight adhesions. On opening the organ an ulcer was found about the middle with thickened mucous membrane around. Microscopically the base of the ulcer was found occupied by new growth, and a small nodule of carcinoma found on either side.

The patient is now in good health.

Case 10.—June 9, 1923. Miss E. H., age 63. (Dr. Malcolm Donaldson.) History of metrorrhagia for ten years, with occasional pain in the back and weakness after the attacks. At the operation the appendix appeared nodular, and was removed as a matter of routine.

After removal the uterus was found to contain a soft fungating fibroid in its cavity, and its body was occupied with many hard fibroids. The appendix is very short, and its distal end contains a soft, nodular, and yellowish growth in which tiny calcareous points are present,

The patient was seen in February, 1925, and was in good health.

Case 11.—June 2, 1924. Mrs. S., age 60. (Mr. Eric W. Sheaf.) The patient's symptoms pointed to some abdominal lesion, and clinical investigations left some doubt as to whether the gall-bladder or appendix was affected. A laparotomy revealed an appendix showing very marked chronic inflammatory changes, and it was removed. The gall-bladder was found to be normal, and no other lesion was discovered. Short, thick, and white appendix. The tip is bulbous and solid.

The patient is much better since the operation.

The number of cases in the above series is too small to furnish any accurate statistics of age and sex incidence. It is interesting to observe, however, that five patients had reached or passed the age of 50 years. Of the remainder, two were between 30 and 40, two in the twenties, and one patient was only 19 years of age. The youngest of all, a girl of 11, presents two exceptional features—the growth occurred in the body of the appendix and consisted of two nodules. It is worth noting in connection with the last two cases that, although carcinoma occurring in young people usually grows rapidly and soon destroys life, these two patients were alive and well two years after the growths were removed. The sexes are represented by 4 males and 7 females.

QUOTATIONS AND ABSTRACTS FROM VARIOUS AUTHORS.

These are added in order to illustrate the views held by observers who have investigated the problem as to the nature and origin of this growth.

Bowlby and Andrews, *Surgical Pathology and Morbid Anatomy*, 1920, 7th ed., p. 553 :—

"Malignant disease may also simulate simple inflammation of the appendix. It is a comparatively rare condition, and is seldom diagnosed before operation. The growth may be a columnar-celled carcinoma, but in several cases which have been recorded the disease has been of a singularly chronic nature, devoid of any tendency to give rise to secondary growths and occurring at an earlier age than is usually the case in true cancer. The microscopic appearances in these cases has been not unlike those seen in endotheliomata of the parotid region."

Bland-Sutton, *Tumours Innocent and Malignant*, 1922, 7th ed., p. 368 :—

"Primary cancer of this small segment of the intestinal tract has been recorded by many observers, but it differs pathologically and clinically from cancer occurring in any other region of the body. It presents itself as a small nodule in the thickened wall of the appendix; the nodule rarely exceeds a cherry-stone in size. Microscopically it consists of nests of spheroidal cells. No special symptoms are associated with these small tumours. Though in structure they mimic cancer, there the likeness ends, for the nodules do not invade adjacent structures, nor recur after removal, nor disseminate. The patients are usually about 30, but these nodules are found in children and adolescents."

Robert Muir, *Text-book of Pathology*, 1924, p. 456 :—

"True carcinoma may originate in the appendix, but this is very rare. A less uncommon type of growth, however, occurs as a small nodule usually situated towards the free extremity, and presenting an alveolar structure like a cancer. Such a growth may be very minute, and may be accidentally found on microscopic examination. The cells are somewhat small, and are irregularly arranged in closely packed masses in the submucous coat, though extending into the other coats. In cases of this condition which we have seen we have found no evidence whatever of active growth, and this has been the general experience. It is doubtful whether malignant disease develops in connection with the lesion, although this is a possibility. The term cancroid may be suitably applied. The lesion probably represents a collection of epithelial cells dislocated in the process of development, and the condition, as Aschoff suggests, is comparable to the groups of 'nævus' cells which are present in pigmented moles of the skin."

ROLLESTON AND JONES, *Trans. Med. Chir. Soc.*, London, 1906, xxxix. An important paper in which is incorporated the literature up to 1906. The authors make an historical survey and give an analysis of the figures relating to incidence, age, associated conditions, etc. Their cases include growths in other parts of the intestines, both spheroidal-celled and columnar-celled carcinoma.

The following description of the microscopic structure of two specimens examined at St. George's Hospital is given :—

" The arrangement of the growth is alveolar, the cells occupying the alveoli are round and polyhedral, small, and somewhat resembling those of rodent ulcer. There is a scanty margin of clear protoplasm around the nuclei, which stain deeply and show nucleoli. The cells are in close contact and fill the alveoli, but in some alveoli there are one or two clear spaces, apparently due to degeneration of the surrounding cells. The spaces thus produced are more often empty, but may contain spindle-shaped cells like those forming the walls of the alveoli. This vacuolated appearance is a striking feature of the growth. The alveolar walls are delicate, and formed of spindle-shaped connective-tissue cells.

" It may be difficult to determine the starting-point of the tumour . . . but we incline to the view that it is the mucosa which becomes replaced by spheroidal-celled growth and from the cells of Lieberkuhn's crypts."

The authors refer to a case of multiple primary growths of the ileum and jejunum included in their series, and go on to observe :—

" The histological nature is evidently the same as in those spoken of as primary spheroidal-celled carcinoma of the vermiform appendix. Further, the growths in both cases are nearly always benign, and in this respect, it is true, resemble some form of endothelioma more than spheroidal-celled carcinoma."

KELLY AND HURDON, *The Vermiform Appendix and its Diseases*, 1905 :—

" The size of the tumour varied from 5 to 12 mm. in most cases up to that of a pigeon's egg in others."

" The tumour appeared as a firm white nodule fairly definitely circumscribed, but cannot be shelled out, and in places the margin gradually merges into the surrounding tissue."

The authors go on to state :—

" Only a few of the cases of carcinoma of the appendix conform to the usual type of glandular intestinal carcinomata. The majority of cases belong to a less usual type consisting of round, oval, or irregular alveoli filled with small polymorphous cells, having a scanty protoplasm and sharply-stained vesicular nuclei. Mitotic figures may be seen. In but few places is there any evidence of a glandular formation. Generally, however, where the growth is traced to its origin in the mucous membrane a lumen may be detected in one or two of the alveoli, and it is usually possible to trace a direct histogenetic relationship between the tumour and the crypts of Lieberkuhn."

" The tumour shows a distinct local invasive tendency penetrating the submucous and muscular coats with but few exceptions."

ELWELL, " Primary Malignant Disease of Vermiform Appendix ", *Quart. Jour. Med.*, 1908. The author divides the growth into columnar-celled and spheroidal-celled carcinomata. In referring to the second group he remarks :—

" If these tumours are spheroidal-celled carcinomata originating in the columnar cells of Lieberkuhn's glands, they should be most actively malignant. The desire

to avoid the discrepancy afforded by the innocent behaviour of tumours so malignant in structure has prompted several suggestions.

"(*A*) Appearances due to inflammation. (*B*) Form, position, and structural peculiarity of the appendix. (*C*) Growths may be adenoma or endothelioma."

The above quotations serve to show the large amount of time and thought that the various authors have devoted to the study of this curious little tumour. It will be noted that, in the effort to provide a satisfactory answer to the problem as to the real nature of the tumour, the writers have advanced various explanations. Some of these are different from mine, but as my account was written before seeing their articles, I think it best to let it stand. It represents the conclusion arrived at after many years' study of morbid anatomy and careful study of the microscopic sections of tumours. The drawings appended have been made from selected portions of the sections, and will, I hope, serve to illustrate truly and fully the various points which have caused me to arrive at these conclusions.

I am disappointed at my failure to obtain definite information, either from my own series or the medical literature, of the malignant course of any case. The authors whose articles I have quoted have grouped the ordinary columnar-celled carcinoma cases with the spheroidal-celled type. It is impossible, therefore, to prove how many, if any, of the latter have run a malignant course. The impression gathered from their remarks gives one the idea that almost all the cases pursue an innocent course, but some are malignant. In view of the case reported by Dr. Callender, I think we are safe in assuming that this is correct. If it had only been possible to obtain microscopic sections of the appendix tumour in his case, the evidence would have been conclusive.

No doubt the above authors have, as is my experience, been faced with the difficulty of tracing patients after operation, and so have not been able to complete the cases. Another difficulty is the length of time which may intervene before other growths develop after any primary lesion has been removed. To mention but one instance, a man, alive and well twelve years after resection of a carcinoma of the sigmoid. Many other similar cases could be given.

It is impossible to tell the duration of time taken for the development of these appendix tumours, such little bodies as they are, tucked away in a large sac like the peritoneum. The presence of calcareous specks in No. 10 of my series suggests a slow and lengthy course of growth, and the patient's age rather supports this view.

A CLINICAL STUDY OF ELEVEN CASES OF VESICAL DIVERTICULA.

By R. OGIER WARD, London.

Various deformities of the bladder are included under this name. Septic paravesical cavities, which have established communications with the bladder, may be called false diverticula. Traction pouches may form as the result of adhesions to neighbouring organs, and the part of the bladder which is not infrequently found in hernial sacs has been considered to belong to the same group; also those pouches, which sometimes persist at the apex of the cavity owing to incomplete obliteration of the urachus, are true diverticula of the bladder. I have no examples of these conditions to report; moreover, they are quite distinct from the diverticula or pouches (*Fig.* 80) which form the subject of this article, and which may be defined as cavities lined with mucous membrane and communicating with the bladder by means of a single orifice, which is sharply defined and of smaller diameter than the pouch to which it is the exit. At its opening there is often a ring of muscle, which is sometimes spoken of as a sphincter—a description that is incorrect; there are usually muscle fibres in other parts of the wall of the pouch, and particularly near its orifice, but these are commonly scanty and never as abundant, or in such uniform layers, as those of the bladder itself; the mucous membrane lining the cavity is continuous with that of the bladder, though it is not often so well formed, and its submucosa is very attenuated; externally the sac is covered by layers of connective tissue fixing it more or less firmly to neighbouring structures. Often there is evidence of past or present inflammation in all the layers.

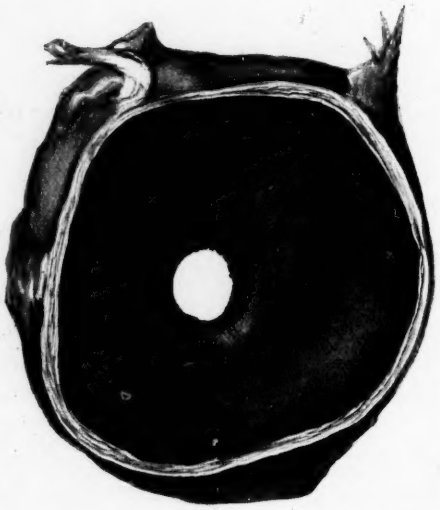

Fig. 80.—The interior of a vesical diverticulum; the opening into the bladder is seen. The fundus has been cut away (operation specimen).

Mr. W. E. M. Mitchell has kindly examined microscopically specimens of most of my cases. He reports that all the coats of the bladder are represented in the diverticula. The mucous membrane is usually thin, and so is the submucous coat, in which there is often inflammation. The muscular layers vary in thickness, but some muscle fibres are always present. At the orifice these are specially abundant and may be considered as a sphincter, although a well-formed trabeculum would give the same appearance in section.

Such diverticula may be single, or there may be two of them sometimes placed symmetrically, or they may be multiple; in which case one of them is often large, whilst the others are of trivial dimensions. They vary in size from that of a hazel-nut to a sac as large as, or even larger than, the bladder itself.

I have tried to ascertain if such diverticula occur in animals other than the human species, and it seems clear that they are very rarely found. Legueu and Papin,[1] in their recent admirable article, quote one case, which has been reported, of bilateral vesical diverticula in a Bengal monkey. But this case is the only example I can find.

Sir John M'Fadyean very kindly writes from the Royal Veterinary College as follows: "I can find no reference to the occurrence of diverticular bladder of any of the domestic animals, and I have never seen anything of the kind myself. There are a good many records of the occurrences of what was called the urachus cyst connected with the bladder; but these are quite clearly due to persistence of part of the urachus after birth".

Sir Arthur Keith, Dr. C. F. Sonntag, anatomist to the Zoological Society, and Mr. W. P. Pycraft, of the Natural History Museum, also tell me that they have never met with the condition—an important statement, for each of them has a very wide experience of examinations of all sorts of animals.

Vesical diverticula are of considerable importance, for they may be the cause of serious trouble to the patient, and though the diagnosis is sometimes very difficult, they are in most cases easily recognized if suitable methods are employed, and can usually be removed by a properly-planned surgical operation.

Diverticula do not form a large proportion of those vesical diseases which require surgical treatment. In the last ten years 924 operations upon the bladder were performed at St. Peter's Hospital, and only 27 of these were for the removal of diverticula. Therefore 11 male patients, upon whom I have operated for this condition, seem worthy of report, for they serve to illustrate the symptoms met with, and certain of the complications that may arise; also the results of treatment can be examined. Notes of one of these, which is of special interest, are given later; the others are not recorded in detail, but are discussed in the course of the article.

The origin of these diverticula is uncertain; the various views of different authors were recently summarized by Girling Ball,[2] and are very fully discussed in the article by Legueu and Papin. By many it is held that, although they may not manifest themselves till late in life, they are always due to a congenital predisposition. For it is pointed out that they most frequently occur at certain places in the bladder which are developmentally weak, namely just above the ureteric orifices, in this position being often symmetrical; or less commonly just behind the interuretic bar. Certainly, in the course of routine cystoscopies, it is not rare to find small recesses in the mucosa above and behind the openings of the ureter; and these may well be the precursors of true diverticula which develop later in life when some obstruction has occurred to the outflow of urine from the bladder. Another view is that they are formed from accessory ureteric buds.[3]

In the present series of cases there are two examples of solitary diverticula opening close above the ureter, slightly internal to it in one, and in the

other slightly external; two others had similarly situated diverticula with smaller sacculi near them; and there is one example of an orifice immediately behind the interureteric bar, almost in the mid-line. One patient had symmetrically placed diverticula with openings just lateral to those of the ureters; and in two others there were a fully-formed diverticulum on one side and some smaller ones in a corresponding position near the opposite ureter. Thus the situation of the pouches in these eight cases shows that they originated in those parts of the bladder where the musculature is known to be congenitally weak. In two others, the openings were far on the posterior wall of the bladder and far removed from the ureters.

One diverticulum was almost certainly congenital. This was in a boy 15 years old. Cystoscopy showed the trigone well formed except at its left outer angle; here its boundaries disappeared into the opening of a diverticulum, and when this was removed by operation, the interuretic bar was found to be continued into it as a well-marked ridge upon its inner and posterior side. On this ridge, about 1 in. from the bladder, was the opening of the left ureter, which was quite normal in appearance. Outside and rather above the opposite ureteric orifice, which was normal, was a shallow depression in the bladder wall, and in it were several small recesses. Elsewhere, except for a slight degree of trabeculation and some cystitis, the bladder was healthy, and there was no obstruction either at its outlet or in the urethra. A cystogram of this case is shown in *Fig.* 81. The bladder is seen in the middle of the pelvis rising vertically over the shadow of the sacrum. The diverticulum lies obliquely, extending towards the left ischial spine, but being also visible to the right of the middle line, and it is nearly as large as the bladder itself. This case may, perhaps, be considered a variety of the rare deformity known as double bladder.

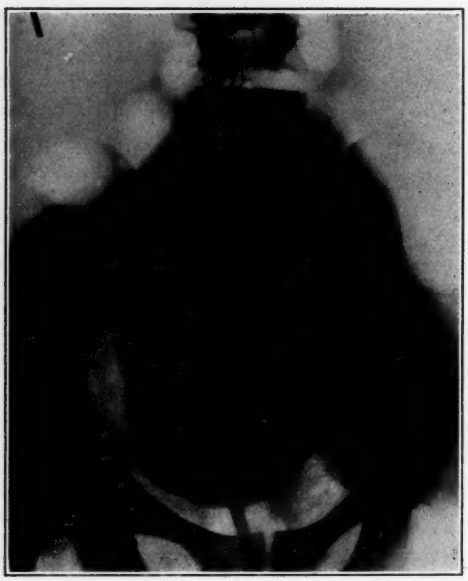

FIG. 81.—The shadow of the catheter enters the bladder. The diverticulum lies behind, and projects to the right of the picture.

When diverticula occur apart from any obstruction to the outflow of urine from the bladder they must certainly be congenital, and the boy is probably an example of this, though one cannot exclude the possibility that at some period of life a defect had existed in the neuromuscular mechanism controlling the emptying of his bladder. But even when obstruction is present, it may well be argued that this has merely made obvious the presence of a pre-existing pouch by causing a great increase in its size, or perhaps an infection of its contents. In illustration of this possibility there may be mentioned two patients who gave histories of old strictures which had been treated at

intervals for many years, and five who were proved to be suffering from enlargement of the prostate, which was obstructing the emptying of the bladder. In two others, although the prostate was slightly enlarged, the removal of the diverticula was sufficient to reduce the residual urine to less than 1 oz.; and since cystoscopies carried out one year later showed no further development of sacculation, it is assumed that the obstructive factor here is a small one, and will prove too slight to effect further changes in the remainder of the bladder.

It is well known that vesical diverticula are decidedly uncommon in women, who are, of course, much less liable to interference with the proper emptying of the bladder than are men, and although from time to time one sees shallow sacculi near the ureters in the female bladder, yet well-formed diverticula in the female are comparatively rare. This must give force to the view now generally held, and supported by the study of these patients, who were all males and, except for the boy, all between forty-four and sixty-eight years of age, that although diverticula of the bladder can be entirely congenital in origin, and occur apart from any obstruction, yet such cases are much less common than those in which obstruction is present. And this, though often of slight degree, is, when added to a congenital predisposition, an important cause in the production of the majority of diverticula large enough to give rise to symptoms. It must be stated, however, that true diverticula can also result from obstruction alone, and an illustration is afforded of this by one patient who had suffered from a narrow urethral stricture for some years, with marked difficulty of micturition and attacks of retention. When the bladder, which was much distended, had been emptied, its wall was more than $\frac{3}{4}$ in. thick; multiple diverticula were present, three of which were larger than hens' eggs, and had an unusual amount of muscle in their structure. Their orifices were on the posterior and postero-lateral aspects of the bladder, well away from the areas in which the musculature is normally somewhat defective; and the smaller sacculi, which were very numerous, opened, for the most part, the same regions. The multiplicity of these pouches, their disposition, the presence of severe urethral stenosis, and the very marked hypertrophy of the bladder, make it exceedingly probable that they were an acquired condition entirely due to the greatly increased intravesical pressure, and not associated with any pouches of congenital origin.

SYMPTOMS AND COMPLICATIONS.

The more moderate-sized diverticula do not, as a rule, give rise to *symptoms* unless they become infected. The larger diverticula, even before infection occurs, usually give the patient sufficient discomfort to cause him to seek medical advice. The symptoms observed in these eleven cases will now be examined, and it will be seen that they are often due to some *complication* which has arisen.

The boy of 15 would not have consulted his doctor had not an infection of his bladder and *hæmaturia* occurred, for until he was 13 he considered himself perfectly well in every respect; then he began to get pain, referred to the end of the penis during micturition, with some urgency; sometimes

he would be free of this for a month or two, but he gradually got worse. He had no difficulty in micturating, and the stream was normal, except that he noticed that the urine first passed was often turbid, though it became clearer as the bladder emptied. Slight frequency of micturition was present, five times by day, and once by night. He took little heed of these symptoms, however, and only became interested when, on several occasions during the last six months, he passed blood intimately mixed with his urine. When examined, his urine contained some blood and was turbid from the presence of pus. Cystoscopy showed generalized cystitis, also the diverticulum which has been described. As the left ureter opened within it, only the right ureteric orifice could be seen through the cystoscope. Presumably the hæmaturia was due to inflammation of the diverticulum or of the bladder, for no other cause could be found; and since the operation, a year ago, there has been no recurrence. One other patient had suffered from intermittent hæmaturia for seven months, which was the result of inflammation. It was never severe, though occasionally small clots were passed, and removal of the diverticulum has cured it completely.

But the commonest cause of hæmaturia associated with this abnormality is not uncomplicated inflammation, but the presence of one or more *calculi* in the bladder or diverticulum. It is not surprising that *inflammation* should occur, and that calculi should form; for though the wall of the sac usually contains muscle fibres, yet this musculature is always inferior in development to that of the bladder itself. The ring of muscle, which is often seen around the orifice, has only some of the functions of a sphincter, and these only in a very imperfect degree. Therefore, when the patient micturates, the bladder empties itself in two directions, namely, through the internal urinary meatus into the urethra, and through the partly contracted orifice into the diverticulum. When the bladder is empty the diverticulum sometimes discharges its contents, but usually the act is very incompletely performed, and probably, in every case, some urine remains in it, even if special postures are adopted to encourage drainage by gravity, and, indeed, even after catheterization. This fact can sometimes be demonstrated by a cystogram taken after the patient has been allowed to void as much as he can of the opaque fluid, for it will show the diverticulum to remain partly filled. These conditions of stagnation are ideal for the occurrence of cystitis and the formation of calculi, the diagnosis of which may sometimes be difficult.[4] One case, in which such a complication was present, is worth describing in detail from this point of view.

The patient was a man who in 1923 was aged 48; when eight days old he had been so crudely circumcised that most of the skin of the penis had been removed, and an acquired glandular hypospadias produced, with stenosis of the urethral orifice. He had been under treatment at St. Peter's Hospital since 1907, and the urethra had been gradually dilated to size 13/15 English. In 1914 cystoscopy showed general cystitis, normal ureteric orifices, with clear effluxes, and there was generalized trabeculation. The stricture contracted when he did not attend for treatment, and gradually his cystitis got worse, the urine becoming very foul, gravel was passed, and hæmaturia occurred on many occasions.

In 1923 I found that he had 4 oz. of very offensive residual urine, and stones could be felt in the bladder. Through the cystoscope a rather poor view was obtained of an intensely inflamed bladder and a calculus in it. In June he was admitted to hospital, and an X-ray (*Fig.* 82) showed three calculi to be present. In

spite of the fact that it could be seen that the stones were not in contact with each other, I wrongly assumed that they were all in the bladder, and performed litholapaxy. As this did not cause much bleeding, I cystoscoped him before he left the table, and though the visibility was far from perfect, no calculus or fragments could be seen in the bladder. His symptoms soon recurred, and, in October, cystoscopy showed two calculi in the bladder, which was much inflamed and very irritable. Litholapaxy was again performed; on this occasion, after the calculi had been crushed and evacuated, another could be felt with the lithotrite, but could not be gripped by it. A radiogram taken a few days later showed this calculus clearly, and through a cystoscope it could now be seen partly projecting from a diverticulum, which opened above the left ureteric orifice. There were also some shallow sacculi above the right ureter.

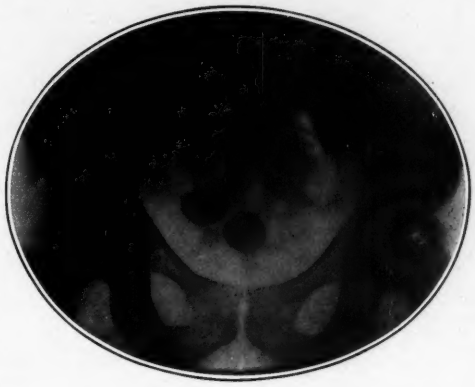

FIG. 82.—Calculi in the bladder and in a diverticulum.

Further treatment had unfortunately to be postponed until April of the next year. By this time another calculus had formed in the bladder. At operation, the stone in the diverticulum was found to be tightly fixed in it, with a mushroomed surface the size of a shilling extending into the bladder cavity.

The faults of diagnosis and treatment are well exemplified here. X rays not infrequently show more calculi than have been visible by cystoscopy, for some may be hidden by those nearest to the internal urinary meatus; but when one or more of these shadows are seen to be remote from the others, the probability is that these calculi are outside the bladder itself. Such calculi are shown in *Fig.* 83, which is an X-ray of a patient who had suffered from a stricture for many years, and also an enlarged prostate, and who, it may be mentioned, had, like the other cases now being considered, recently passed blood in his urine. At operation, a soft calculus, probably chiefly composed of blood-clot, was found in the bladder. This is seen as a faint irregular shadow in the centre of the pelvis; two well-formed calculi were also found, each lying in symmetrically placed diverticula, the larger being on the right side. These are clearly seen in the radiogram to lie so far from the position usual for bladder calculi that they must be outside its cavity, and therefore, having regard to the patient's history, certainly to be calculi lying in diverticula. But even if the appearances are not so obvious, it is sound

FIG. 83.—One large and one smaller calculus lying in symmetrically placed diverticula. The faint shadow of a vesical calculus is also seen.

practice to have further X-rays taken after litholapaxy, if cystoscopy beforehand has not clearly excluded such possibilities.

Another, but much less frequent, cause of hæmaturia is the presence of a *new growth* associated with a diverticulum, or in rare cases growing within it. I have only one example to report (*Fig.* 84). The diverticulum, which contained a small friable calculus, opened high up on the posterior wall of the bladder, and was about the size of a bantam's egg. Close to its orifice was a spheroidal-celled carcinoma, slightly larger than a hazel-nut, which extended almost up to it, whilst by its extension through the bladder wall it had attached itself to the exterior of the pouch. Hæmaturia had first been noticed five years previously, and not again until twelve months before he reported for investigation. Since that date it had recurred frequently. Though there was slight enlargement of the prostate, which was the cause of some frequency and difficulty of micturition from which he suffered, the bleeding was clearly from the growth, and the soft calculus had formed in blood-clot. After operation there was no more hæmorrhage.

Hæmaturia, in association with vesical diverticula, may be due, therefore, to inflammation, to the presence of calculi, or to a new growth; and it may, of course, be due to the coincidence of an enlarged prostate. One of my cases had suffered from it intermittently for four months; there were several shallow sacculi and a small diverticulum, which only admitted the terminal phalanx of the index finger. His prostate was enlarged, and was the cause of the bleeding and of the presence of 4 oz. of residual urine, for after prostatectomy, without removal of the pouch, the bladder emptied completely and hæmaturia ceased.

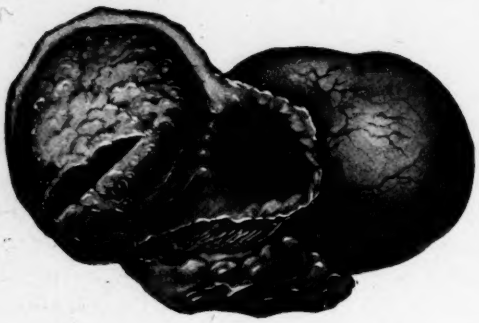

FIG. 84.—A vesical diverticulum with a carcinoma close to its orifice (operation specimen).

Hæmaturia is a warning which a patient does not often allow to pass unheeded, but it is, of course, not so common an event in this disease as is the occurrence of *troubles of micturition* of various kinds.

'*Miction en deux temps*' is often considered pathognomonic of vesical diverticulum, but it must be remembered that it sometimes occurs in tabetic affections of the bladder and urethra, and in a lesser degree in enlargement of the prostate. However, it is a very important sign and strongly suggestive of this condition, but it should be clearly understood that this is not a common symptom. Only one of my cases presented it, and it was not invariably present; he had a large diverticulum (*Fig.* 80) holding more than half a pint of urine, opening behind the interureteric bar, almost in the middle line, with a smaller one beside it.

Frequency of micturition is often met with, and this common symptom is usually to be explained by the cystitis which so often results from the presence of the pouch; in other cases it may be due to an enlarged prostate.

Difficulty of micturition, in these cases, often results from the association of an enlarged prostate, or stricture, but may be produced by the diverticulum itself; one patient had suffered from this in a marked degree for four months, but said he could overcome it entirely if he micturated whilst lying on his back. The diverticulum opened above and behind the right ureteric orifice; it was as large as the bladder itself, containing probably more than 15 oz. of urine, and extending deeply into the pelvis (*Fig.* 85); on one occasion *retention* of urine had occurred; these troubles were entirely removed by its excision. The explanation of retention in this disease which most writers have offered, and one which would account for it, at any rate, in most instances, is that the presence of such a diverticulum interferes with the proper action of the trigonal musculature, one of whose functions is to open the internal urinary meatus at the commencement of the act of urination. Two other patients had also had retention of urine, presumably from the same cause. The first had two diverticula, one the size of a walnut, and one not larger than a hazel-nut; both opened near the left ureter. The other was the man whose bladder musculature was so greatly hypertrophied and who had multiple acquired diverticula. Even after two of the three largest had been removed, and a urethral stricture excised, retention persisted.

FIG. 85.—Cystogram. The bladder shadow is spherical, and below the diverticulum lies obliquely, and extends higher up.

Pain is a symptom usually present when inflammation has developed, and four cases of this class presented it in the form typical in cystitis. One patient, however, who had severe cystitis, would not admit that he had ever suffered from it. Four others, who were free of all inflammation, were also free of pain. There remain two whose pains cannot be explained by cystitis, but must be directly attributed to the presence of a diverticulum, which in each instance was a large one. The first was the man previously mentioned, who had occasionally 'miction en deux temps', and it was the onset of this pain more than the frequency and slight difficulty of micturition which caused him to consult his doctor. It was related to urination, occurring just before urine commenced to pass from the urethra, being really severe and felt particularly in the left groin, and to a much less degree in the perineum. It ceased as soon as micturition was finished. This was probably due to the forcing of urine into the diverticulum, and the stretching of the adhesions which, as is so often the case, surrounded it.

The other was the man who, as previously stated, suffered from difficulty in passing urine except when in the supine position. Fifteen months previously

he had at times experienced pain in the urethra during urination, but this had passed off. The pain of which he chiefly complained, and which he considered a more serious part of his malady than the attack of retention of urine which had once affected him, existed for a year and a half, and took the form of an aching in the region of the left posterior superior iliac spine, which spread down the posterior aspect of the left thigh, and caused him to be lame; he was, in fact, suffering from left sciatica. The diverticulum, as has been said (*Fig.* 85), was almost as large as the bladder, and lay behind the left lower part of the bladder, extending deeply beneath the peritoneum into the pelvis, and being in contact with its left lateral and posterior boundaries. Since its removal the neuritis has disappeared entirely. He attributes the cure directly to the operation, and it seems reasonable to agree with him, for it is probable that the diverticulum was in contact with the coverings of the sciatic nerve in the pelvis, and certainly there were adhesions in this region.

In addition to the complications which have already been discussed, and the possibility of *rupture* of the sac, two others, which are less common, may be mentioned. Firstly, *compression of a ureter*, for this duct is often in close contact with the sac, and from this may result hydronephrosis and the risks of renal infection, though it did not happen in any of my cases. And, secondly, *constipation* from pressure upon the rectum. One of the two patients suffering from very large diverticula complained of this, for his bowels had always acted regularly until recently, when it became necessary, after passing a motion, to defæcate again an hour or so later.

DIAGNOSIS.

The most important method of diagnosis available in this condition is, of course, *cystoscopy*. If a good view is obtained, the opening of the pouch with its sharply-defined margins is seen as a black hole in the bladder mucosa, unless, indeed, it is only a shallow pouch, in which case its walls are usually visible. The appearance is very characteristic, and easily distinguished from the small sacculi so commonly seen in the trabeculated bladder; but unless the cystoscopy is a thorough one, and all parts of the bladder are systematically examined, it is quite possible that, even if no special difficulties are encountered, the opening might escape observation, although most of the diverticula have their openings near the ureters, which is usually the region most closely inspected. Sometimes a diverticulum can be palpated through the abdomen, but not unless it is a very large one, or takes origin in the upper parts of the bladder. More often they can be felt on rectal examination as a smooth elastic tumour above and behind the prostate, but it would, of course, be unwise to base a diagnosis on this finding without confirming it by cystoscopy, since several other conditions need to be excluded. Through the cystoscope not only can the opening be seen, but a *ureteric catheter* can be passed into the diverticulum, and an estimate thus formed of its size. Sometimes, but not often, the cystoscope passes into the diverticulum. This happened in the case of the man who had sciatica; and the glistering whiteness of its relatively anæmic wall contrasted well with the yellow pinkness of the more vascular bladder mucosa.

The size of a pouch can be best estimated by means of a *cystogram*. The bladder and diverticulum are filled with opaque fluid through a catheter. It is very useful to watch this under a screen, and, when it is completed, to take photographs in whatever positions are best calculated to show the form and extent of the pouch. (*Fig.* 86.) Other photographs should be taken after the catheter has been allowed to drain, or the patient allowed to micturate. (*Fig.* 87). Radiograms should also be taken apart from cystography, for, as has been seen, they may reveal calculi whose existence would otherwise not be suspected.

Simple *catheterization* does not necessarily give any indication of the contents of a diverticulum, for the reasons that residual urine may also be

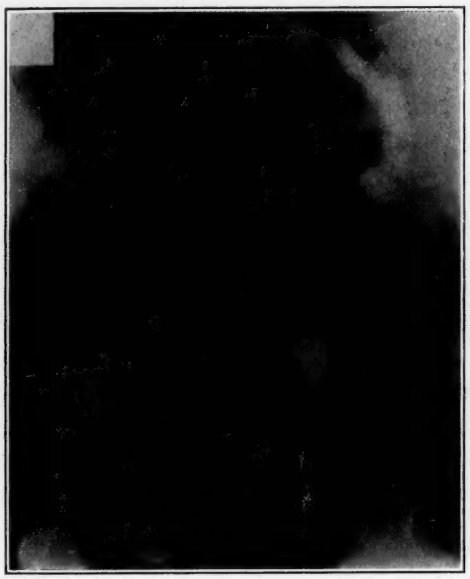

FIG. 86.—Cystogram showing a small diverticulum as a small circular shadow imposed on that of the bladder.

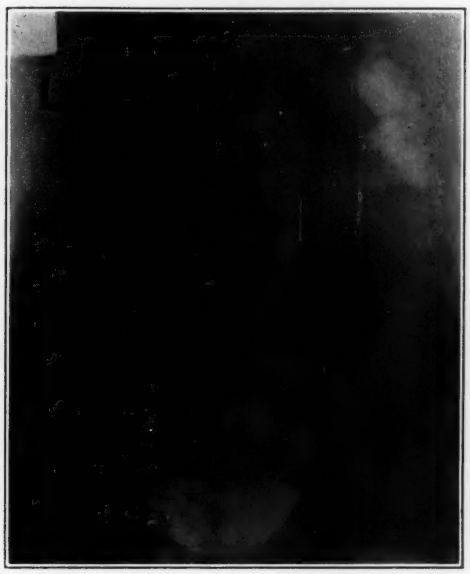

FIG. 87.—Same as *Fig.* 86, catheter withdrawn; micturition has emptied the bladder but not the diverticulum.

present in the bladder itself, and also that very frequently it is quite impossible to empty a diverticulum by any other means than swabbing it out, or emptying it by suction through the bladder opened suprapubically. Fortunately, however, the other means at our disposal already mentioned, namely, the use of the cystoscope with a ureteric catheter, and the radiographic methods of examination, enable us to determine, in all but quite exceptional cases, the presence or absence of a bladder diverticulum, together with its position, and to form a fairly accurate estimate of its size.

It may be well to point out that it is a serious matter to overlook the presence of a diverticulum in dealing with a case of enlarged prostate, or of any other form of urethral obstruction; for operation will not be followed by relief of symptoms and restoration to health if a diverticulum of any considerable size is also present and not removed. On the contrary, pyuria

will persist, and disorders of micturition, though perhaps somewhat diminished, will continue to exist.

TREATMENT.

It is because vesical diverticula cannot diminish, but must inevitably increase in size, and because infection so very commonly occurs, that the proper treatment is to excise them.

Palliative Treatment.—If, for any reason, an operation cannot be performed, palliative treatment must be tried with the object of encouraging drainage of the contents into the bladder, and so diminishing sepsis. The outlook is not promising, because irrigations through a catheter really only cleanse the bladder itself, for the reason already stated, namely, that these pouches are unable to get rid of their contents because of the lack of competent musculature in their walls, and often because of the position of their orifices. The best form that palliative treatment can take is to encourage the patient to find some position in which he can perform 'miction en deux temps', and, when he has effected this, to wash out his bladder through a catheter, repeating the process several times. Such methods are not without danger, and are obviously a very imperfect form of treatment.

Operative Treatment.—The operative treatment of vesical diverticula has been very fully described in a recent paper by Swift Joly.[5] He points out that a preliminary cystostomy should be avoided if possible, since it drains only the bladder, and makes it more difficult than ever to wash out any of the contents from the diverticulum, since the bladder cannot now be distended, and therefore the irrigations fail to pass through the closed orifice into the pouch. If the sepsis is too great to risk immediate excision of the diverticulum, or if the patient's renal efficiency is so poor that preliminary bladder drainage is essential, then, as he suggests, it is best to pass two tubes through the bladder and the opening of the diverticulum into its cavity, so that the irrigations be circulated thoroughly through it. Marsupialization of the pouch has been recommended for such cases, but is not so good an expedient. Any system of drainage should be used for as short a period as possible, because of its manifest imperfections.

The *excision* of a vesical diverticulum is always an interesting and sometimes a difficult operation. The space in which the operator has to work is confined, and the freeing of the fundus of the sac from the pelvic floor, as is often necessary, demands good illumination, and that the patient should be in the Trendelenburg position. I think that such a posture is not good for old men, and should be used for as short a time as possible. It is only this, and the necessity of disturbing severely the attachments of the pelvic peritoneum, that make the operation a severe one, for otherwise there is little shock, and bleeding is comparatively slight.

It is convenient to begin by mobilizing the distended bladder as widely as possible, usually without opening the peritoneum, though, if it is opened on purpose or accidentally, it should be closed before the bladder is incised. This should be done at the stage when it is decided that a finger inside the diverticulum will facilitate the dissection of it from the surrounding tissues. It should be emphasized that careful dissection is the important part of the

operation, and must be carried out with precision and under good observation; otherwise there may be troublesome bleeding from the veins on the pelvic wall, and there is real danger of damaging a ureter; for this structure is always in close relationship with a large diverticulum, or one of any size arising from the lower part of the bladder, being either on its posterior wall or lying in the recess between it and the bladder. A catheter in the duct during this part of the operation is helpful, but even this will not prevent its injury if the dissection is not carried out under view. It is the close relationship of the ureter which constitutes one of the chief dangers of operating entirely from within the bladder, and attempting, by volsellum forceps or other means, to invert the sac into it. Other obvious risks, which make such a proceeding thoroughly unsound, are possible damage to peritoneum or bowel; it is, moreover, entirely unnecessary. Small diverticula, and especially those that lie deep, may sometimes advantageously be removed by a transvesical operation, in which the orifice is encircled by an incision through the mucous membrane and the other coats of the bladder wall, and the diverticulum gradually dissected from its outer attachments whilst it is being drawn like a detached and empty glove-finger into the bladder; one of the operator's fingers inserted into it may help in effecting this. But such a procedure depends for its success upon the careful external dissection of the sac, and by this means it is possible to avoid injury to other structures which may well follow attempts to turn it inside out by force,

However, the procedure that will be found most generally useful is, as has been said, to mobilize the bladder widely before opening it; next, to empty it, and to continue the freeing of the diverticulum with the help of a finger inside it; then, as suggested by Swift Joly, to incise the bladder down to and around the opening of the pouch, so that in the last stage of the dissection it is free from attachment to the bladder. The gap in the wall of the latter is then sutured, and one drainage tube is usually placed outside it for a few days, and one into the bladder cavity in the manner usual after cystotomy.

It is well to remember that operations in the pelvis are never easy in the presence of obesity. Apart from this, the difficulties vary with the position of the pouch, those extending deeply into the pelvis requiring special care; and also with the amount of adhesions produced by inflammation; often a plane of cleavage is found in which the dissection of the sac progresses easily, and in any case it is wise to keep as close to the latter as possible. In the absence of sepsis no harm will result if some small part of the fundus of the sac is left in the pelvis, and it may sometimes be well to rest content with this result.

Diverticula were excised from nine patients, and all survived the operation. Two months later one who had quite recovered from this died, after a prostatectomy, from a pulmonary embolism on the third day. The other eight are alive and cured.

It is important to realize that in this disease it is very often insufficient merely to excise a diverticulum, for an obstruction should always be suspected until its non-existence can be proved. No obstructive factor was present in the case of the boy of 15, and he was completely cured of his symptoms by the excision of the pouch; it was, of course, necessary to reimplant the left

ureter into the bladder, but, as far as can be seen one year after the operation, the kidney has in no way resented this, and the patient is quite well. However, in four of the older patients, from whom diverticula were excised, prostatectomy was necessary for their complete cure. In one of these there was very obvious enlargement of the gland: this was the man who died. In two others, however, rectal examination showed no enlargement at all; nor did cystoscopy reveal any; and indeed it only became clear that there was such an abnormality when the suprapubic wound would not close. In one case, this was at length effected by tying a catheter into the urethra, but two days later the wound reopened and would not heal again. In each of these cases an adenomatous prostate, no bigger than the normal gland, was then enucleated, and uninterrupted healing of the wound led to a speedy and complete cure.

In the fourth example—the man who had a vesical carcinoma as well as a diverticulum—a small adenomatous prostate, recognized at the first cystoscopy, was removed for increasing symptoms one and a half years later.

In two patients the pouches were not excised; one of these, from whose bladder and diverticula calculi were removed by cystotomy, was submitted to prostatectomy three weeks later, and nearly a month after this operation he died of bronchopneumonia. A post-mortem examination showed the bladder almost completely healed. In the other, prostatectomy only was performed, and the diverticulum, which admitted the terminal phalanx of a finger, was left *in situ*, and it seems unlikely that its removal will become necessary.

NOTES ON THE YOUNGEST PATIENT IN THIS SERIES.

V. E., age 15. Apparently a healthy boy, at work, and playing games. For two years had suffered from pain after micturition, referred to the end of the penis, with occasional intermissions for two or three weeks. The urine first passed had been turbid; towards the end of micturition it became clear. Six months ago, and on several subsequent occasions, hæmaturia had occurred, the blood being intimately mixed with the urine and never in very large amounts. Usually had to get up once at night to pass urine, and did so five times by day; occasionally frequency had been more marked. The stream passed was normal in size and projection, and there had never been any difficulty in micturition.

On Examination.—He appeared perfectly healthy, except that his urine contained pus and blood and a small amount of albumin. Cystoscopy showed the opening of a diverticulum at the left outer angle of the trigone, occupying the normal position of the left ureter, which could not be seen. The right ureter was normal, and so was the rest of the bladder except for some cystitis and a slight pouching of the bladder above and external to the right ureter, and here were two small and shallow recesses.

Operation.—The bladder was exposed suprapubically and freed from the peritoneum; it was then opened. The diverticulum, which was unusually thick, was found to be lying very deeply in the left side of the pelvis, from which position it was freed by the dissection of its exterior. With the help of a finger inside it, the left internal iliac vessels and the vas were exposed, and there was a good deal of bleeding, which, however, was easily controlled.

The bladder wall was then incised down to and around the orifice of the diverticulum, and on raising this the left ureter was seen entering its posterior aspect. It was cut across and implanted again into the upper part of the lateral incision in the bladder wall, since it could not easily be brought down to the usual position of entry. The bladder was drained, and a smaller tube was placed outside it to drain the pelvis.

The wound was sutured in the usual manner. The operation, including induction of anæsthesia, took nearly two hours, and the patient stood it well.

Recovery was uneventful. One year later the patient reported that he had been perfectly well ever since the operation. The wound was well healed, and the urine normal. There was no longer any pain on micturition, or frequency by day or night.

CONCLUSIONS.

1. Vesical diverticula may be entirely congenital in origin, but usually obstruction is associated, and causes them to become large enough to produce symptoms.
2. The commonest symptoms result from infection of the stagnant urine in the pouch.
3. The cystoscope and cystogram provide accurate means of diagnosis.
4. Excision is necessary for cure, and the results are good.
5. When obstruction is present, it also usually requires operation.

I have much pleasure in acknowledging my indebtedness to Mr. Kenneth Walker, who kindly provided me with three cases for operation, to Mr. W. E. M. Mitchell for his report upon the microscopic appearances of the operation specimens, and to Mr. Thornton Shiells for his drawings of operation specimens.

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POLYPI IN THE BOWEL CAUSING INTUSSUSCEPTION.

By W. E. M. WARDILL, Newcastle-on-Tyne.

That polypi in the bowel are frequently seen at operations for intussusception is a matter of common experience, but I venture to suggest that the relationship between the two conditions is ill-understood and may give rise to errors

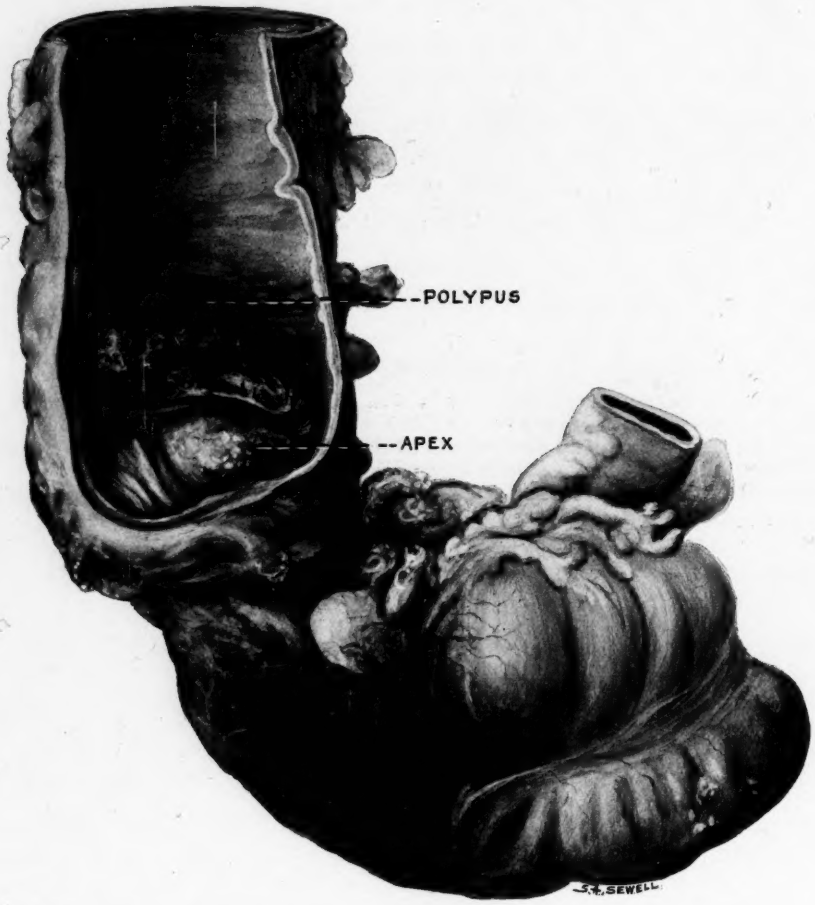

Fig. 88.—Submucous lipoma at the apex of a colic intussusception.

of omission on the part of the surgeon. The pitfalls of abdominal surgery are sufficiently numerous, and the scope of this note is to point out yet another.

One always assumes that when a polypus of the bowel is associated with intussusception there is a relationship of cause and effect. Such, no doubt,

is the case. The polypus is usually regarded as being dragged along by the peristaltic movements, and its point of attachment being thereby invaginated and forming the starting-point or apex. *Fig.* 88, showing a polypoid submucous lipoma of the colon at the apex of an intussusception, is illustrative

FIG. 89.—Diagram illustrating the mechanism of production of the intussusception shown in *Fig.* 88.

of this, and the diagrams (*Fig.* 89), are intended to explain the mechanism of its production.

But that this simple explanation does not account for all cases—one might even say the majority—is amply proved by reference to many operation and

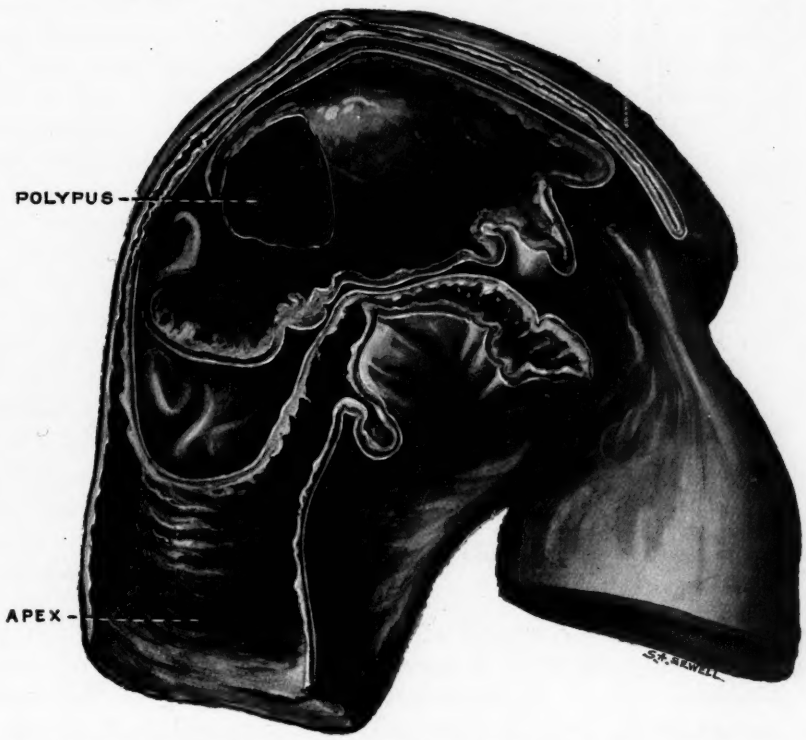

FIG. 90.—Submucous angeioma of the jejunum with intussusception. The tumour lies some distance proximal to the apex.

museum specimens. *Fig.* 90 is drawn from a specimen of intussuscepted submucous angeioma of the jejunum. The tumour in this case occupies a position which is some considerable distance proximal to the apex, although it is still included in the intussusceptum. *Fig.* 91 depicts an intussusception

caused by an inverted and polypoid Meckel's diverticulum, previously reported by Mr. Hamilton Drummond.[1] Here, again, the attachment of the polypus is some distance proximal to the apex of the intussusception. A fourth specimen (*Fig.* 92) shows an enteric intussusception associated with an adenomatous polypus, which is not even included in the intussusceptum, but lies far on the proximal side. This specimen is of considerable interest, because it represents the recurrence of an intussusception after an operation for the same condition some years previously.

It is obvious from the examination of these specimens that mere traction upon the polypus by intestinal movements does not account for the formation of the intussusception. The probable explanation is that the tumour, lying within the lumen of the bowel, acts as a foreign body and produces spasmodic contraction of the gut around it, with inhibition of that part immediately distal. The conditions are now favourable for that final act of peristaltic gymnastics whereby the contracted part is induced to slip into the dilated portion (*Fig.* 93).

FIG. 91. — Inverted Meckel's diverticulum with intussusception. The attachment of the diverticulum is proximal to the apex of the intussusception.

Lindsay and Perrin[2] have adduced evidence to show that the intussusception of infants is associated with inflammation of the lymphoid tissue in the lower ileum, and they offer this as an explanation of the age incidence. Such an explanation is welcome, since it obviates the necessity of taking refuge in terms like perverted peristalsis, where the bowel is expected to display suicidal tendencies for no apparent reason. Moreover, it puts the intussusceptions of infancy on the same footing as those associated with polypi and growths. If the explanation given by myself of the relationship between the polypus and the bowel is accepted, it is easy to see the mechanism of production of the ileocæcal type of intussusception. No dragging of the bowel wall by the foreign body need be assumed; the terminal part of the ileum simply contracts violently and is pulled by its longitudinal muscle into the cæcum, which is relaxed ready to receive it. Once an apex is formed, the intussusceptum itself becomes the foreign body, and attempts are made to expel it, with the result that more and more invagination takes place. The same mechanism which produces the first intussusception is capable of producing a second and forming a double intussusception, and, theoretically, this process might continue until the bowels were like the familiar series of

boxes within a box. There is a limit to this, however, in the distensibility of the ensheathing layer.

The moral to be drawn from the above observations is that, when operating for intussusception, particularly in subjects over the age of two

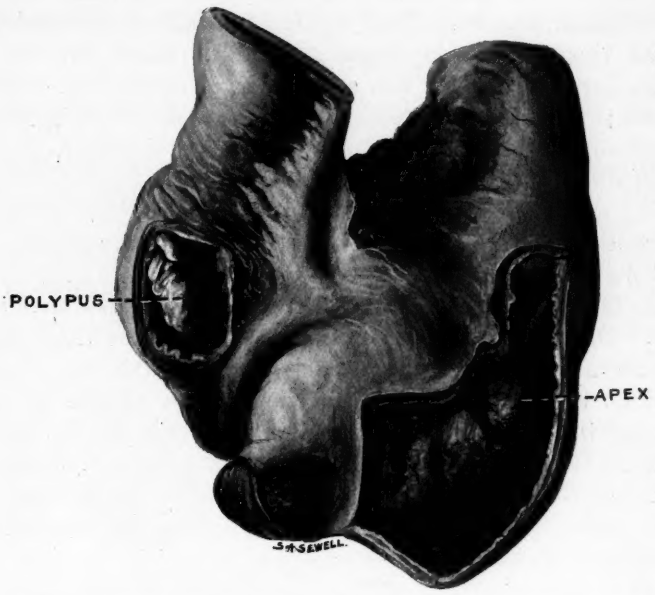

FIG. 92.—Adenomatous polypus of the small intestine causing recurrent intussusception. The tumour lies in a proximal position, and is not even included in the intussusceptum.

years, careful examination should be made of the proximal healthy bowel for possible polypi. Neglect of this precaution may result in recurrence, immediate or remote, as illustrated by the specimen shown in *Fig.* 92. Knowledge of this relationship helped me in the following case, of which I give short notes.

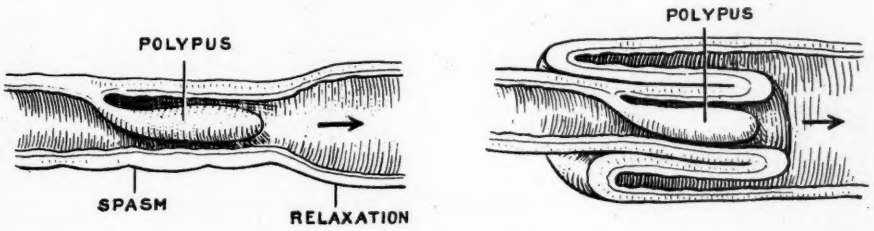

FIG. 93.—Diagram illustrating the usual way in which a polypus starts an intussusception.

A man, age 43, had suffered for seven months from intermittent abdominal pain. During the last fortnight the pain became more severe, and he had difficulty in getting his bowels moved. Two days before admission to hospital the pain became very bad, and he passed bright-red blood with his motions. When I saw him, he complained bitterly of agonizing pain, and demanded

relief at any cost. The abdomen was slightly distended, and there was a small amount of free fluid. A mass, somewhat obscured by the distention, was felt in the situation of the descending colon and was thought to be growth. At operation, this turned out to be an intussusception of the colic type. It was apparently of recent origin, and was easily reduced, there being no adhesions. After reduction, the bowel was carefully examined for growth, but none could be felt at the site of the intussusception. Some four or five inches proximal to this, however, there was a small hard carcinoma confined to one wall of the bowel; it had no relation to the intussusception, and had one not been on the look-out for a possible tumour in this situation it might easily have been overlooked, and the abdomen closed without the true nature of the disease being recognized. The condition of the patient did not warrant further interference, so a safety-valve cæcostomy was performed as a preliminary to future operation.

Three weeks later, the abdomen was opened again for the purpose of removing the growth. On examining the site of the disease, the intussusception was found to have recurred, and on this occasion the growth was actually in the intussusceptum at the apex. There was no œdema of the bowel, and the appearances suggested that recurrence had taken place, at the earliest, a few hours before operation. The diseased bowel was removed, and anastomosis done by the method of Fraser and Dott. Recovery was uninterrupted.

The drawings in this note are from specimens in the Durham University College of Medicine, Newcastle-on-Tyne.

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INTERSCAPULO-THORACIC AMPUTATION FOR CARCINOMA OF BREAST.

By SIR CUTHBERT WALLACE, K.C.M.G., C.B., London.

On two occasions recently an interscapulo-thoracic amputation was performed for advanced carcinoma of the breast.

The problem was to provide a covering for the raw surface left after wide removal of the breast. In the ordinary fore-quarter amputation the line of union between the anterior and posterior flaps runs on the outer side of the thorax. In an amputation for carcinoma of the breast, the line of union must be at the sternum, for it is necessary to sacrifice the anterior flap which

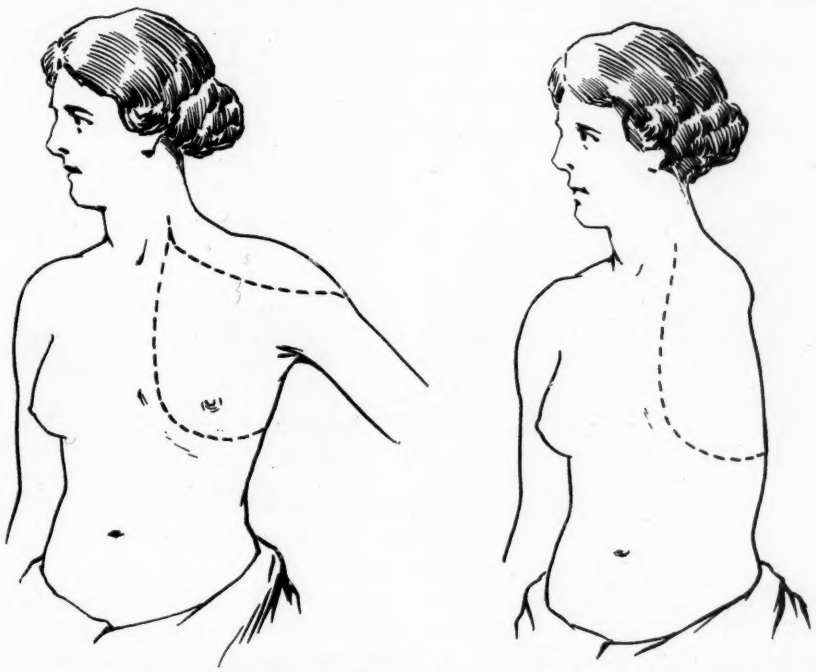


Fig. 94.—Interscapulo-thoracic amputation for carcinoma of breast.

contains the tumour. The skin to cover the front of the chest must come from the posterior flap, which thus has to reach the sternal edge.

In planning the incision in the first case, it did not seem possible that the posterior flap could reach so far, and preparations were made for an extensive graft taken from the forearm of the amputated limb. The result showed, however, that a posterior flap could be fashioned that would reach the sternal edge.

In the second case advantage was taken of the experience gained in the first, and the contour of the flap was somewhat modified, with the result that accurate and easy coaptation of the skin was obtained.

The incision started over the sternomastoid, about 3 in. above the clavicle, passed down to and over the sternoclavicular articulation; it then turned outwards 2 in. below the clavicle, crossed about 2 in. above the angle formed by the junction of the skin of the chest and the arm; then across the deltoid, sloping slightly downwards to the point where the posterior aspect of the arm joined the body; then backwards and downwards almost to the angle

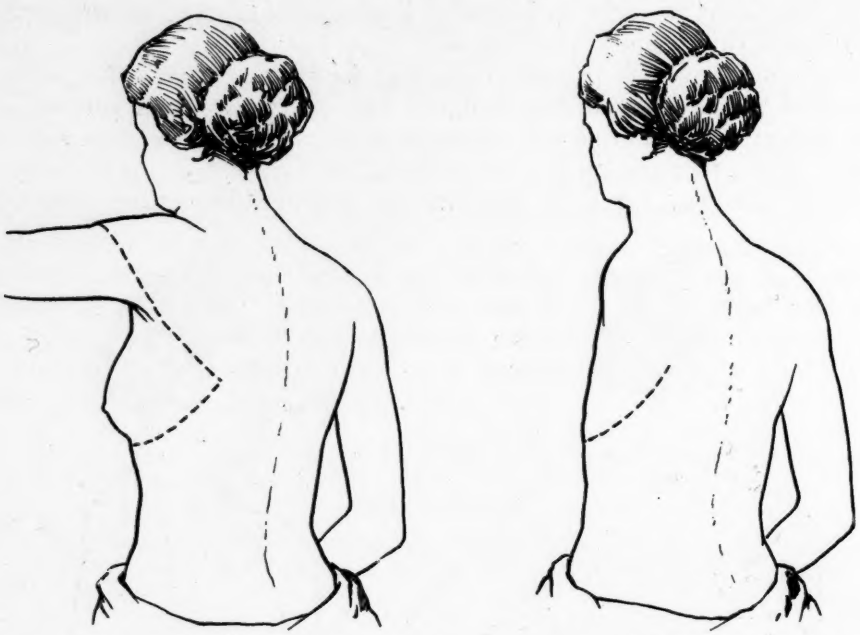


FIG. 95.—Back view of operation shown in *Fig.* 94.

of the scapula. From this point it turned forwards, crossed the axilla horizontally below the border of the mamma, and reached the sternal edge, which it followed to the sternoclavicular articulation.

By turning the superior flap upwards, it was quite easy to divide the muscles on the superior and vertical border of the scapula and turn forwards the upper extremity and detach it from the thorax. The continuation of this process enabled the arm, scapula, pectoral muscles, and mamma to be removed in one block. (*Figs.* 94, 95.)

The shock was no greater than that encountered in many breast operations.

In each case a small part of the anterior edge of the skin-flap necrosed, but otherwise the flaps healed well.

SHORT NOTES OF RARE OR OBSCURE CASES.

TWO CASES OF POLYPUS OF THE STOMACH.

By T. B. MOUAT, Sheffield.

The following two examples of mucous polypus of the stomach illustrate the complications which may be set up by this relatively infrequent condition, for in both a partial inversion of the stomach wall had resulted from the drag of the pedicle of the tumour, which had been extruded from the stomach into the duodenum. In the first case obstructive symptoms were present, and the distended duodenum had perforated, while in the second the polypi showed malignant changes, and one of them had become ulcerated and given rise to hæmorrhage from the stomach. In the absence of complications, the diagnosis would appear to depend on the presence of a palpable tumour in the pyloric region, which gives a characteristic rounded and sponge-like filling defect in the radiograms of the stomach after a barium meal.

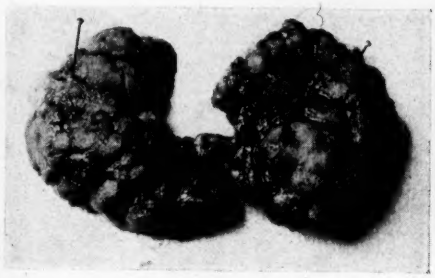


Fig. 96.—*Case* 1.
Mucous polypus of stomach.

Fig. 97.—*Case* 1. Pen drawing of slide.

Case 1.—Harriet T., age 12, was admitted to the Royal Infirmary, Sheffield, on June 16, 1924, suffering from diffuse peritonitis. For the past twelve months she had been troubled with recurring attacks of epigastric pain and vomiting, which lasted for three or four days. Between these attacks she appeared to be in quite good health. The vomit was described as being "just like chopped grass". The present illness commenced six days

ago with the same symptoms, which continued till the day before admission, when the pains grew very acute, and she became collapsed.

On Admission.—The patient appeared a fairly well-grown but thin girl, with a pinched, dusky face and sunken eyes. Pulse 135. Temperature 100°. Generalized abdominal rigidity, with some distention, and signs of free fluid in the peritoneal cavity.

Operation.—On opening the abdomen through a right paramedian incision, gas and a copious purulent odourless exudate escaped. The incision was enlarged upwards, and adherent lymph was seen on and around the

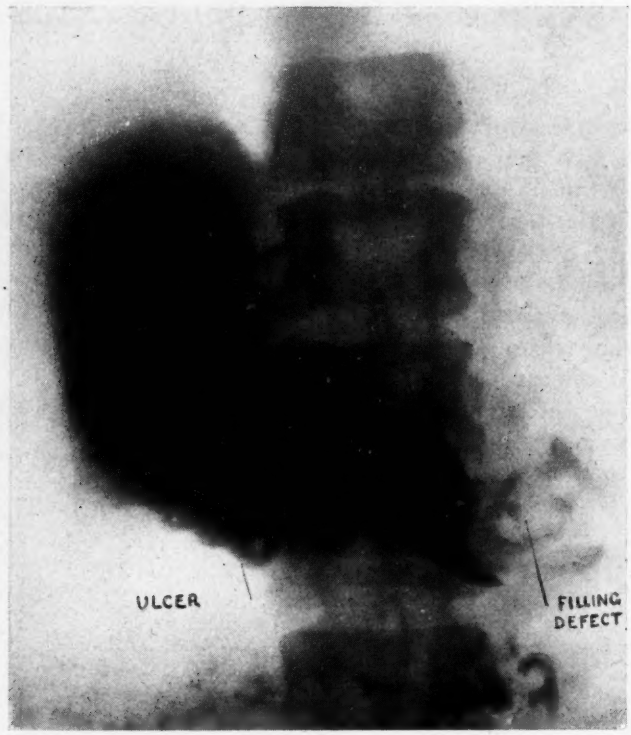


Fig. 98.—*Case* 2. Radiogram of stomach.

duodenum. The pylorus and the first part of the duodenum were distended, and on grasping these segments of the gut to pull them down for closer inspection, a large mass was felt to slip from the duodenum back into the stomach. It was then noticed that the perforation lay concealed under the duodenal attachment of a rounded fleshy band which ran between the under surface of the liver and the anterior aspect of the first part of the duodenum, and appeared to have resulted from stretching of old adhesions. This band was removed, and the leaking perforation, which was round in shape and about one-eighth of an inch in diameter, was invaginated.

The stomach was now opened, and the tumour, which proved to be a large mucous polypus attached by a short pedicle to the posterior wall of the

stomach near the lesser curvature, was removed with a small portion of the mucosa at the site of attachment. The gap in the mucosa and the incision in the anterior wall of the stomach were sutured. The purulent exudate in the peritoneal cavity was swabbed out, and the pelvis drained through a separate suprapubic 'button-hole' incision.

The after-progress was uneventful; the drainage tube was removed on the second day, the patient went home with both wounds healed in the fourth week, and remains in good health.

The gross appearance and microscopic structure of the specimen are shown in *Figs.* 96 and 97.

FIG. 99.—*Case* 2. Resected portion of stomach, showing malignant ulcer of the greater curvature and two polypi in the pyloric antrum.

Case 2.—Thos. W., age 40, a colliery corporal, was admitted to the Royal Infirmary, Sheffield, on Sept. 25, 1924. His mother had died from cancer of the stomach at the age of 47.

In excellent health till about the end of June, 1924; he then began to be troubled by a dull pain in the pit of the stomach, which became worse after food. The appetite was poor, and he lost a stone and a half in weight. He stopped work on July 23, and four days later vomited a washhand-basinful of blood. The pain became extremely severe, and he sent for his doctor

(Dr. Ritchie, Hoyland Common, Barnsley), who kept him in bed and gave him medicine. The pain lasted for about a week, but there was no recurrence of the vomiting, and since then he has gradually felt better. He attended hospital as surgical out-patient on Aug. 18. A rounded tumour about the size of a golf ball could be felt in the pyloric region, and he was advised to come into hospital for operation. On Sept. 22 he came back to the hospital to tell us he felt so well that he wanted to resume work; but as the tumour could still be felt in the epigastrium, he was dissuaded from doing so, and was admitted on Sept. 25.

Radiograms of the stomach after a barium meal showed a filling defect at the pylorus, and an oblique ulcer niche on the greater curvature (*Fig.* 98).

FIG. 100.—*Case* 2. Pen drawing of slide.

OPERATION, *Sept.* 29.—An indurated and obviously malignant ulcer was found on the greater curvature about three inches from the pylorus. The pylorus was greatly enlarged and appeared to be stretched over a rounded mass which protruded into the first part of the duodenum, and which slipped back into the stomach when the parts were handled. A partial gastrectomy was performed by Pólya's method, the stump of the stomach being brought down through the mesocolon after completion of the anastomosis. The patient made an uninterrupted recovery, and left hospital at the end of the third week.

The resected portion of stomach (*Fig.* 99) shows on the greater curvature the oblique ulcer cleft, which appears to have resulted from breaking-down of a malignant nodule, and two polypi, which are attached to the walls of the pyloric antrum. The edges of the ulcer and the polypi showed well-marked malignant changes, and the pen drawing (*Fig.* 100) shows the structure of the less malignant portion of the larger polypus.

INTUSSUSCEPTION OF THE SMALL INTESTINE EXTRUDED THROUGH A FÆCAL FISTULA ON THE SURFACE OF THE ABDOMINAL WALL.

By E. T. C. MILLIGAN, London.

The patient was a boy, age 11, with a fæcal fistula resulting from an enterostomy performed six months previously by another surgeon to relieve post-operative intestinal obstruction following acute appendicitis for which the child had been operated upon seven days before. At the operation for intestinal obstruction, the first presenting coil of distended intestine—which proved to be 1 foot proximal to the ileocæcal junction—was selected for the enterostomy. The child developed scarlet fever a few days subsequently,

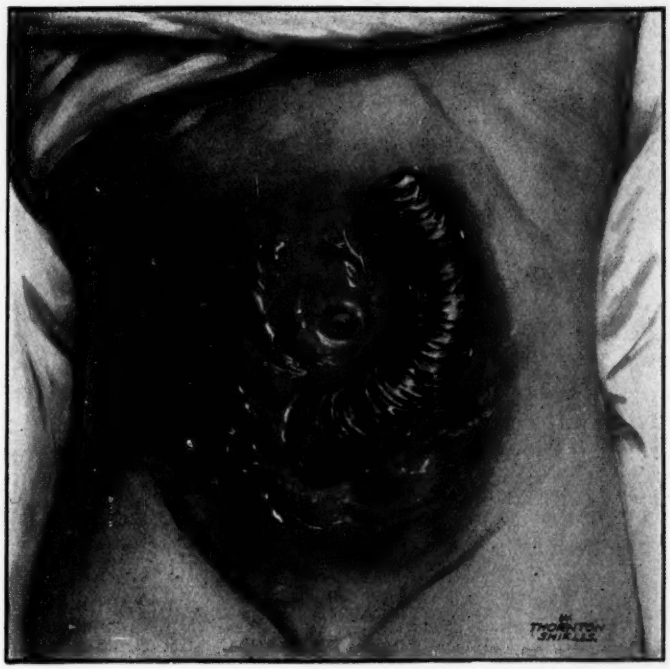


Fig. 101.—Intussusception of small intestine extruded on the surface of the abdominal wall.

which delayed the closure of the enterostomy. The abdominal wall became very red and ulcerated by the action of the intestinal contents.

Present Illness.—On July 10, 1924, six months after the previous operations, the child suddenly experienced an attack of abdominal pain and vomiting. The pain recurred several times. In the intervals of freedom from pain the child was quiet, but pale in appearance from shock.

When operated upon, about nine hours after the onset, there was presenting on the abdominal wall about 8 in. of small intestine intussuscepted and

extruded through the fæcal fistula. The intussuscepted bowel consisted of entering and returning layer, there being of course no ensheathing layer, so that the mucous membrane of the bowel was presenting. The intussusception was curved, bluish red, and congested from constriction at the point of exit from the abdomen, and bled readily on manipulation.

Attempts at reduction failed owing to rigidity of the bowel and constriction at the skin opening of the fistula.

Operation.—The scar surrounding, and the fistulous opening in the abdominal wall, were excised, the abdomen being opened by prolonging the resulting wound upwards and downwards. Resection of the intussusception was then performed and an end-to-end anastomosis made. The intussusception seemed to have started about 4 to 5 in. proximal to the fistula. No cause was discovered. In spite of the unhealthy condition of the skin of the abdominal wall, healing occurred by first intention, and recovery was complete and uneventful.

Fig. 101, which Mr. Thornton Shiells has made from rough drawings at the time and from description, is an excellent picture of the appearance at the operation.

CASE OF VON RECKLINGHAUSEN'S OSTEITIS FIBROSA.

By A. RENDLE SHORT, Bristol.

Miss D., age 46, was sent to me by Dr. Ward, of Wotton-under-Edge, suffering from pain and swelling of the right knee.

History.—As long as she could remember there had been some bony swelling about the knee and also of the fingers of the right hand; she suffered from fits between the ages of 20 and 30. Six years ago, after an injury, there was synovitis of the knee, which cleared up; eighteen months ago the fluid returned without obvious cause, but again gradually cleared up. Four months ago the joint swelled again and has not improved.

On Examination.—The patient is small-made but intelligent. General health is good. There is no thyroid tumour palpable. There are a number of large nævo-fibromata on the chest, abdomen, and right hand, of very long duration. The right knee is very swollen, with soft irregular bosses arising from the tibia and the femur; there is no fluid present. It is very tender and painful. The right hand shows, in addition to the nævo-fibromata, bony swelling of the phalanges, especially at their bases; on account of the deformity two fingers were amputated many years ago. The phalanges are apparently involved in the same disease as the knee. The radius and ulna on the left side are curved, but not expanded. In spite of this, the right arm is shorter than the left.

X-ray Report.—The skiagram (*Fig.* 102), taken by Dr. Mayes, shows extensive changes in the bones entering into the knee-joint. The femur shows a thin shell of hard cortex, enclosing a nearly uniform transparent tissue which extends for several inches up the shaft. Here and there one can see

rounded or elongated denser areas. In front, the cortex has been perforated by the transparent mass, which forms a projecting tongue-like swelling, folded down on to the shaft. The upper end of the fibula shows a similar condition, but it has not extended beyond the limits of the bone. Both the femur and the fibula are slightly expanded. The tibia shows a more localized transparent area, which has bulged out through the cortex both behind and in front. The

FIG. 102.—Osteitis fibrosa: skiagram of knee.

patella retains a hard shell in front, but the rest of the bone is transparent. There are a few dense pearl-like shadows of bone in the capsule of the knee-joint, and the articular surface of the tibia is irregular.

In view of the extensive nature of the disease in the femur and tibia, operation was thought to be contra-indicated, and a walking caliper advised.

Three weeks later the patient was sent to me again on account of great

pain in the knee, inability to put the leg to the ground, and increase of the swelling. The joint was found to be much more swollen, and she could not extend it. It was held semi-flexed, and there was but little movement, and that very painful. The softish boss over the head of the tibia was larger; it did not show eggshell crackling. The fingers were unchanged.

Operation.—As the patient was very averse from amputation, a wide excision of the knee was performed; altogether about 7 in. of femur and tibia were removed. The bony ends were brought together and held in place by a Hallopeau plate, and Parham and Martin bands. There was some delay in healing, and the plate and bands were removed later. After about ten weeks the patient was sent home with the bones ununited, but able to get about

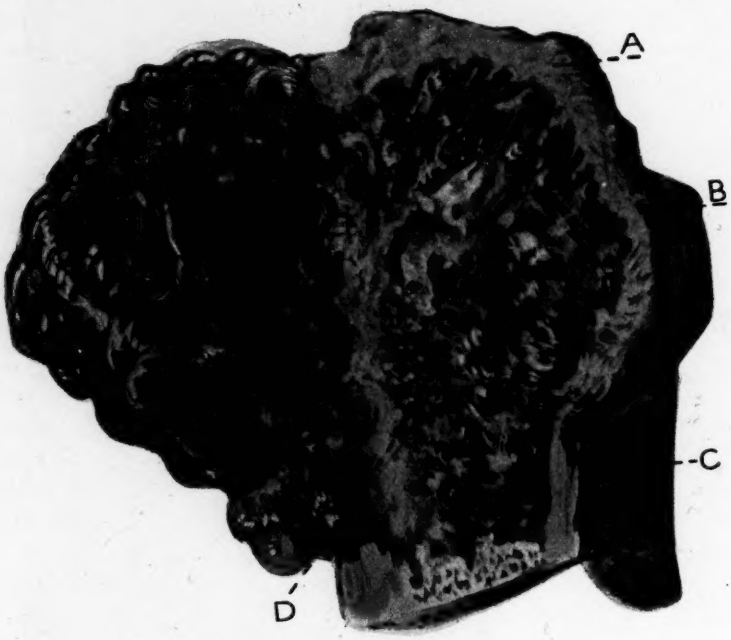


Fig. 103.—Osteitis fibrosa. Section of tibia through tubercle. A, Cartilage; B, Tubercle; C, Fibula; D, Osseo-mucin.

comfortably on crutches with the leg in plaster. Of course she could not put it to the ground on account of the great shortening.

Description of the Removed Bones.—The portions of femur and tibia removed are shown in *Figs.* 103 and 104. Judging by the skiagram, the whole of the diseased area in the tibia was excised, but by no means the whole of that in the femur. However, the cut surface of the femur looked normal. (Its failure to unite suggests that extensive disease was, as a matter of fact, present.)

The tibia was the more grossly diseased. Almost no bone was left of the upper three inches of the tibia; a little remained in the region of the tubercle. The rest had been expanded from within by the growth and eroded away. The articular cartilage remained, but was very irregular in outline. The material occupying the head of the bone was gelatinous in consistency,

with small pearls and rods of cartilage-like material. It varied in colour from greyish-pink in the centre to a red jelly inside the boss at the back of the tibia that had been so painful. Here it was almost diffluent. The fibula appeared normal.

The femur showed less extensive changes. The articular cartilage was thinned and studded with little nodules. The cortex of the bone, though very thin, was intact except just above the patella, where a reddish jelly-like material bulged through, forming a soft swelling like that at the back of the tibia. Elsewhere the femur was completely occupied by a material which had the colour of ordinary bone-marrow in that situation, but softer. No cancellous bone was visible. There was a rod of cartilage-like material lying loose in the middle, well shown in the picture (*Fig.* 104), and some other

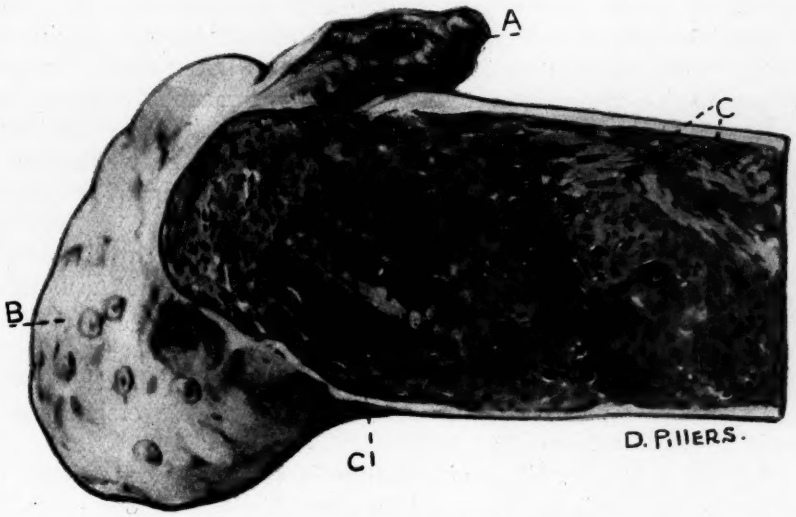


FIG. 104.—Osteitis fibrosa. Section of femur through condyle. A, New growth; B, Eroded surface of condyle studded with nodules; C, Rods and pearls of osseo-mucin looking like cartilage.

areas with little nodules of the same. The substance occupying the femur had not the gelatinous appearance of that found in the tibia.

MICROSCOPICAL REPORT.—Professor I. Walker Hall reports: The tissue shows chiefly the later changes associated with osteitis fibrosa. There is generalized replacement of the bony structure by fibrous tissue. The formation of thin-walled capillaries has been followed by numerous hæmorrhages. The attempt to lay down new bone is evident in the strands of osseo-mucinic and osteoid tissue, but the process has not proceeded very far.

The removal of the bone trabeculæ appears to have been brought about more fully by halisteretic atrophy than by osteolysis and osteoclasis. Osteoblasts and osteoclasts have taken a part which is less pronounced than in some cases. They are present in medium numbers only, and do not present the intensive giant-cell formation hitherto described.

DISCUSSION.

The case is a fairly typical one of von Recklinghausen's osteitis fibrosa, but with some peculiar features.

The various conditions which are grouped under the name of 'osseous dystrophies' have recently been subjected to a careful examination and critical discussion by Dawson and Struthers in a most valuable paper, which draws largely on the extensive researches of von Recklinghausen. The conditions which come under their examination, and enter into the list of possible diagnoses in this case, are: (1) Osteitis fibrosa, generalized or localized; (2) Paget's osteitis deformans; (3) Osteomalacia; (4) Rickets; (5) Myeloid sarcoma, better called 'benign giant-celled tumour' (Ewing).

They point out that the histological features of osteitis fibrosa are an erosion and expansion of the bone with the laying down of new bone on fibrous strands which become converted into osseo-mucin. The Haversian spaces, and later the bone-marrow, are converted into fibrous tissue, with proliferated endosteal cells and, where the bone is being eroded, many giant cells (osteoclasts). There is a tendency to myxomatous degeneration, and cysts, large or small, are plentiful. In addition to these there are tumour-like masses which, both to the naked eye and histologically, may resemble myeloid sarcoma. In their case there was an adenomatous tumour of the parathyroid gland.

In Paget's *osteitis deformans*, the changes are fundamentally very similar, but the giant-cell areas and cyst-formation are absent, and the bone changes are more in evidence.

In *osteomalacia*, there is a simple halisteresis or dissolving out of the mineral salts, leaving zones of decalcified osteoid tissue. There is little or no fibro-osteoid-tissue replacement of the marrow and Haversian spaces, and there are few or no osteoclasts.

In *rickets*, of course, the main change is the exaggerated and irregular cartilage-formation with deficient calcification.

In *myeloid sarcoma*, better called 'benign giant-celled tumour' (Ewing), there is a definite tumour-formation, full of giant cells which are osteoclasts, not myeloplaxes. Osteoclasts have many nuclei; the myeloplaxes or mega-karyocytes of bone-marrow show a single many-lobed nucleus.

In the present case, the very long course, dating from childhood and perhaps from birth, the involvement of many bones and, until recently, the freedom from symptoms, point to osteitis fibrosa. The tibia shows bone erosion and expansion; the femur shows a mixture of bone erosion and new bone-formation within the shell of cortex. The marrow has been converted into fibrous and myxomatous material, and shows in places many proliferated cells, probably endosteal in origin. There is not the thick layer of very porous bone one sees in osteitis deformans. The reddish jelly-like area projecting from the head of the tibia closely resembles a myeloid sarcoma, and could certainly be described as a 'tumour-like mass'.

The peculiarities of the case are the following: (1) The association with many subcutaneous nævo-fibromata; (2) The absence of fractures; (3) The great pain, and the swelling of the knee-joint; (4) The scantiness of osteoclasts

in the sections examined (it may be that examination of other parts of the diseased area might show them); (5) The presence of rods and pearls of osseo-mucin in the region which should have been occupied by bone-marrow, looking to the naked eye like cartilage.

OSSIFYING CHONDROMA OF A RIB MISTAKEN FOR A SARCOMA.

By CECIL P. G. WAKELEY, London.

The interest in this case is of a threefold nature: (1) As to whether or not trauma can be the predisposing cause of chondromata; for in this case there was a very definite history of injury seven years before the growth became noticeable. (2) Because there was marked pulsation to be felt in the upper part of the tumour, with some involvement of the lower cord of the brachial plexus, and the clinical diagnosis first made was that of sarcoma. (3) This diagnosis was supported by the report of the radiologist, namely: sarcoma of chest wall obscuring the scapula with a certain amount of ossification.

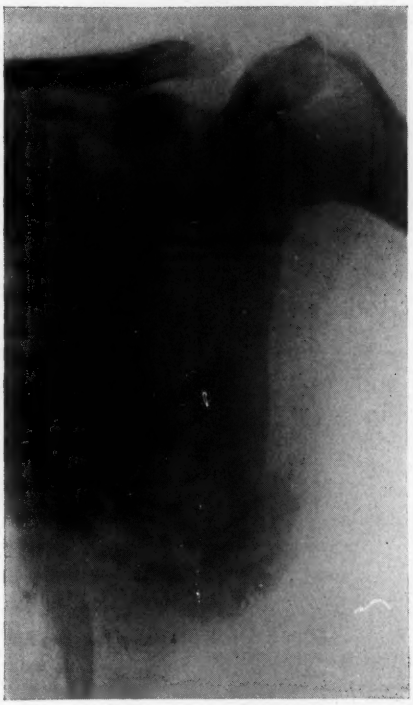


Fig. 105.—Skiagram showing chondroma growing from rib. Definite areas of ossification can be seen.

The following is an account of the case: Mr. W. M., age 42, while in France in 1916, was a machine-gun ammunition carrier. In October, during an engagement, he was carrying a loaded ammunition-drum under his right arm, when suddenly it exploded, causing him severe pain in the right side of the chest; otherwise he was not hurt in any way. The pain disappeared during the rest of the engagement. Soon after this incident the patient noticed a pain in the back of his shoulders which was dull and constant. In November, 1916, he developed nephritis and was sent home to England. The nephritis cleared up, but the pain in the back still persisted, so that he had to give up playing tennis. In August, 1923, one morning while drawing his hand across his chest, he noticed a smooth lump about the size of a walnut; it was hard and immovable, but was not attached to the skin. It was situated an inch above and external to the right nipple. He saw his doctor, who told him it was cancer. A month later he was X-rayed at Swansea and told he had a malignant tumour, and was sent to London for radium treatment. Radium was inserted into the tumour in three

situations. No relief was obtained, and the tumour continued to increase in size. The patient complained of pain and weakness on the inner side of the right forearm, and numbness and tingling in the ring and little fingers. In November, 1923, he had great difficulty in writing, and in February, 1924, had to give up using a pen. He was advised to have an amputation at the shoulder-joint, but he refused and returned to his home. Early in May, he was sent to King's College Hospital with the definite request that deep X-ray therapy should be given to the tumour. A skiagram was taken (*Fig.* 105) which demonstrated an ossifying chondroma growing from the chest wall.

Fig. 106.—Appearance of the tumour after excision.

On Examination.—The patient was seen to be a well-built man of medium height. On the right side of the thorax a large rounded tumour was visible; there was definite pulsation at the upper part. The tumour was hard, irregular, and fixed to the chest wall; the pulsation appeared to be due to the axillary vessels which were no doubt stretched over it. There was slight weakness of the muscles in the forearm and hand which were supplied by the lower brachial-nerve cord. The skin over the tumour was stretched and slightly reddened; there were two small healed incisions where the radium had been inserted. The muscles of the thenar eminence were slightly wasted, but all the muscles reacted well on electrical stimulation. The patient was advised to have the tumour removed, to which he consented.

OPERATION, June 15.—A curved incision was made below the tumour, the lower costo-sternal fibres of the pectoralis major muscle were divided, and the tumour was exposed. In separating the fibres of the pectoralis major from the upper part of the tumour, the first part of the axillary artery and vein and the lowest cord of the brachial plexus were found to be lightly stretched over the tumour, and were separated from it with difficulty. The tumour was fixed to the middle of the fourth rib by a short pedicle of about ¾ in. diameter; this was removed, together with a portion of the rib from which it was growing. The periosteum was separated from the rib previous to removing the latter. The fibres of the pectoralis major were drawn together with

FIG 107.—Sectional view of excised tumour.

catgut sutures, and the skin was closed by interrupted silkworm-gut sutures; a large drainage tube was inserted for twenty-four hours. The wound healed well, and the patient was discharged from hospital at the end of June.

When examined in December, the patient was very fit and well; there was no sign of any irregularity in the chest wall; the defect in the fourth rib could hardly be felt owing to new formation of bone under the periosteum.

The tumour after excision (*Fig.* 106) measured 7 in. by 6 in.; it was lobulated and of a pearly-blue colour. On section (*Fig.* 107) there were definite areas of ossification, and in one place where the radium had been inserted there was a mucoid degenerative area.

The microscopical picture (*Fig.* 108) was that of a typical chondroma. In the centre is seen a group of nutrient vessels, whilst the main feature of the tumour itself is that of apparently homogeneous cartilage containing large

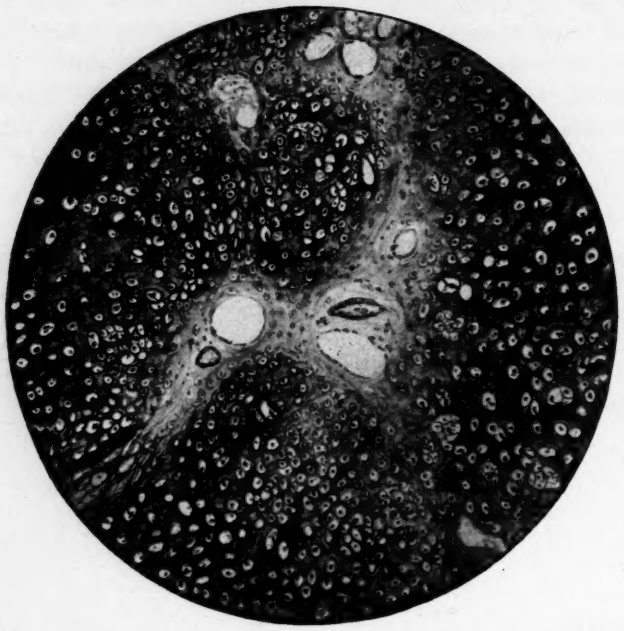


FIG. 108.—Microscopical section of the tumour.

numbers of irregularly distributed but typical cartilage cells. The cells themselves vary greatly in size.

The specimen is now in the museum of the Royal College of Surgeons.

RENAL COLIC AS A LATE COMPLICATION OF NEPHRECTOMY.

BY H. W. B. CAIRNS, LONDON.

THE following case presented the unusual feature of a renal colic occurring eleven years after removal of the corresponding kidney. The cause of this colic and of the other symptoms, which were equally baffling, was discovered by mere chance.

HISTORY.—H. N., male, age 36, was admitted to the London Hospital on March 17, 1923. Ten days earlier he had developed suddenly a typical left-sided renal colic: the pain began in the left loin and radiated to the left lumbar region and the hypogastrium; it was severe and intermittent, and was accompanied by frequent and painful micturition.

The colic had continued, rendering sleep almost impossible, until twenty-four hours before admission, when it suddenly ceased. Three hours later the patient felt a sudden stoppage of the stream while trying to pass water. He strained hard, but could only pass a little blood, while at the same time he felt a stinging pain in the penis. Seven hours later he was still unable to pass water, so his doctor passed a catheter; the relief, however, was only temporary, for when he was admitted to hospital he had acute retention which required immediate catheterization.

PAST HISTORY.—It appeared that the patient had had urinary trouble before. In 1911 he had been in the London Hospital on account of left renal colic, and Mr. Frank Kidd had removed a large stone from the pelvic portion of the left ureter. The ureter, it is stated in the notes, was greatly dilated, "resembling the sigmoid colon". The incision in the ureter was closed by a double layer of chromic catgut stitches. A fortnight after the operation a large, tender swelling appeared in the left loin. This proved to be a hydronephrosis, for which first nephrostomy, and finally nephrectomy, were performed. These operations were successful, and the patient returned to his work and had no further trouble, save for an occasional ache in the left loin, until the sudden onset of his present illness.

PHYSICAL EXAMINATION.— On admission, the only physical signs of importance were the distended bladder and a tenderness in the left loin at the site of the old healed nephrectomy incision. The right kidney was palpable, but neither enlarged nor tender. The urine was alkaline and contained $\frac{1}{12}$ volume of albumin and a deposit of pus and red cells. On cultivation it yielded, later, *B. proteus*.

On the following morning during a further examination of the patient a curious discovery was made. Projecting from the urethral orifice there was a small soft mass—1·6 × 0·6 × 0·5 cm.—the surface of which resembled twisted string. It was removed and sent to the Pathological Institute. Professor Turnbull reported as follows:—

"The specimen consisted of longitudinal and transverse sections of anisotropic rods surrounded by a granular structureless substance. The morphology and staining reactions of the rods were similar to those of a silk ligature in a control section."

Some further examinations were carried out. X-ray examination of the urinary tract revealed no abnormality. The bladder was found at cystoscopy to be normal; the ureteric orifices were of equal size.

SUBSEQUENT COURSE.—After the expulsion of the stitch the patient had no further symptoms. He was discharged from hospital on March 26, 1923, and has reported since that there has been no subsequent trouble.

SUMMARY.

This case would have remained a mystery if we had not had the good fortune to discover the stitch. This made the course of events perfectly clear. At the nephrectomy operation the distal cut end of the dilated ureter was evidently closed by a silk ligature. A slight degree of infection persisted around this fragment of silk, causing from time to time a slight aching pain

in the left loin. Twelve years after it had been placed in position the silk worked loose and was expelled down the still patent ureter to the accompaniment of a sharp attack of renal colic. In the bladder it gave rise to a temporary retention of urine, which could be easily relieved by catheter. Finally, the ligature was discharged at the external meatus of the urethra.

The case emphasizes a point established in recent years, namely, that non-absorbent material should not be used in nephrectomy for ligature of the ureter, particularly when the ureter is dilated. The case also gives an excellent example of the *honesty* of symptoms; in it, as in so many other obscure cases, once the problem is solved, symptoms which have at first sight appeared complicated, incongruous, almost unbelievable, are now seen to be an eminently reasonable expression of the underlying pathological processes and of their development.

My thanks are due to Mr. H. S. Souttar for permission to publish this case.

CYST-ADENOMA OF PANCREAS: COMPLETE REMOVAL.

By SETON PRINGLE, Dublin.

The following case of enucleation of a cyst-adenoma of the pancreas seems to be worthy of record.

Mrs. D., age 40, consulted me in February, 1924, for a "lump in the left loin". She stated that it had been there for many years—probably ten—but at first caused no inconvenience. It gradually increased, however, until at the time of seeking advice the size was such as to interfere with her stooping or even sitting down, the act of bending forward apparently causing it to be nipped between the lower margin of the thorax and the iliac bone. At no time had she suffered any pain of severe character, but latterly there had been occasional vague pains in the left upper abdomen, quite distinct from the acute discomfort produced by stooping. For some months she had had slight frequency of micturition, with some loss of control. The tumour did not interfere with her general health, which had always been very good, apart from an attack of acute rheumatism fourteen years previously.

On examination, it was found that almost the entire left abdomen was occupied by a smooth rounded tumour, extending from the loin behind to almost the mid-line in front, and from underneath the left costal arch to within a hand's breadth of Poupart's ligament. The percussion note over it was dull, except where the lower and left lateral borders were crossed by a broad zone of resonance, due to the transverse and descending colon. The stomach was displaced upwards, lying entirely under the cover of the ribs. On account of the history of some disturbance of micturition, careful examination of the urine was made, but it proved to be quite normal. Cystoscopic examination revealed a normal bladder, but the excretion of indigo-carmine by the left kidney was slightly delayed.

My friend, Dr. Campbell Hall, of Monaghan, assisted me at the operation. On opening the abdomen we found that the tumour presented through the

thinned-out, stretched gastrocolic omentum. This was divided freely, opening into the lesser peritoneal sac; the tumour—as large as a football—was then seen, still covered with the posterior parietal peritoneum, but its size was such that it was impossible to establish its origin. It was obviously cystic in nature, and a large trocar was inserted and some four pints of light chocolate-coloured fluid were aspirated. It then became apparent that it was attached by a broad base to the posterior abdominal wall in the region of the pancreas. At first our intention was to marsupialize the cyst wall, but this was so extensive that we proceeded to excise the redundant portion. The edges of the incision in the cyst wall proper were caught in forceps, and an attempt was made to peel off the covering layer of tissue with gauze-covered fingers, just as a hernial sac is dealt with. This was accomplished with such ease that the process was continued until the whole cystic mass was removed. There was no serious hæmorrhage, and only two ligatures were applied, as the large vessels which ramified over the tumour peeled off with the covering tissues. After removal it was seen that the last portion of the cyst to be shelled out had left an area denuded of peritoneum some 2 in. square on the anterior aspect of the pancreas in its middle third, so that the gland tissue was left quite bare and oozing blood; but there did not seem to be any actual removal of the glandular tissue, and none could be identified with the naked eye as adhering to the excised cyst.

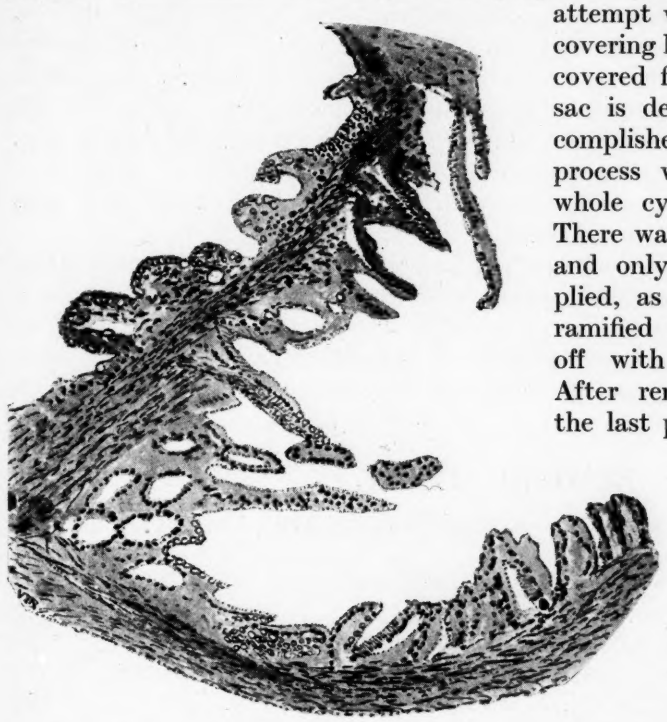


FIG. 109.—Sketch showing microscopic appearances of multilocular cyst-adenoma of the pancreas.

Having satisfied ourselves that no serious hæmorrhage was occurring, the cavity was loosely packed with gauze soaked in liquid paraffin, a large drainage tube inserted, and the edges of the opening were sutured to the anterior parietal peritoneum, thus shutting off the general peritoneal cavity.

Convalescence was uninterrupted except for a rather profuse venous hæmorrhage from the cavity in the second week.

The Pathological Department, Trinity College, Dublin, reports as follows:—

"When examined, the tumour was about 6 in. in diameter, a large quantity of the fluid having been drawn off or escaped. It was composed of one large cyst and a number of smaller ones in close association. The lining

membrane of these cysts was mostly smooth but sometimes velvety in appearance. The small cysts contained a gelatinous material.

"Microscopically, the cysts are lined with a single row of high columnar epithelium with the nuclei at the base, and showing many goblet cells. These are arranged in three forms: as a uniform row, as a singularly regular row of short papillæ, and as a row of long and occasionally branched papillæ; but in every case the single layer is maintained. The stained contents of the cysts are mucous threads and many desquamated cells. The wall dividing the cysts is formed of fibrous tissue, which is sometimes hyaline but more commonly cellular. There is a plentiful blood-supply and occasionally some hæmorrhage—this last possibly due to handling at and after the operation. There are no remains of pancreatic tissues in the walls of the cysts, such as the tissue resembling islands of Langerhans sometimes described in pancreatic cysts. The tumour on the whole closely resembles a cyst-adenoma of the ovary. It is apparently entirely benign, with no evidence of infiltration. (*Fig.* 109.)

"The contents of the main cyst were examined by Dr. Horgan, who reports that he has found all the pancreatic ferments.

"This tumour is to be distinguished from retention cysts of the pancreas by the formation of the papillæ, and by the comparative ease with which it was removed. It is to be distinguished from enteric cysts, which are sometimes found embedded in the mesentery, by its attachment to the pancreas, its multilocular formation, and the presence of pancreatic ferments."

ECTOPIC OVARY.

By ARTHUR EVANS and STANFORD CADE, London.

Cases of incompletely descended ovary are of sufficient rarity to be worthy of record.

Miss E., age 22, was sent to hospital with a diagnosis of recurrent attacks of appendicitis. Her health had been good up till eighteen months before admission. She then had periodical attacks of pain in the right side of the abdomen; these attacks were very severe, and the pain lasted for about twelve hours. There was no vomiting, only nausea occasionally. Pain and tenderness on pressure in the right iliac fossa usually persisted for a few days after each attack. The periods were normal, and had no particular relation to the pain.

The usual gridiron incision was made in the right iliac fossa; on opening the peritoneum the ovary presented in the wound. The cæcum and appendix were normal. The ovary, normal in size, was situated on the outer side of the cæcum. It was sessile, and partially covered by peritoneum. The uterus was mal-developed, and presented the appearance of a left uterus unicornis. The left ovary, tube, and broad ligament were normal. The right broad ligament was absent. The right Fallopian tube was represented by its fimbriated extremity. The ovary occupied a fœtal position with cephalic and caudal poles. From the caudal pole a band stretched downwards towards the brim of the pelvis (ligament of ovary), where it bifurcated, one part going towards

the internal abdominal ring (round ligament), the other band stretching down to the uterus and representing the ill-developed right cornu. In order to remove the ovary the peritoneum attaching it to the posterior abdominal wall

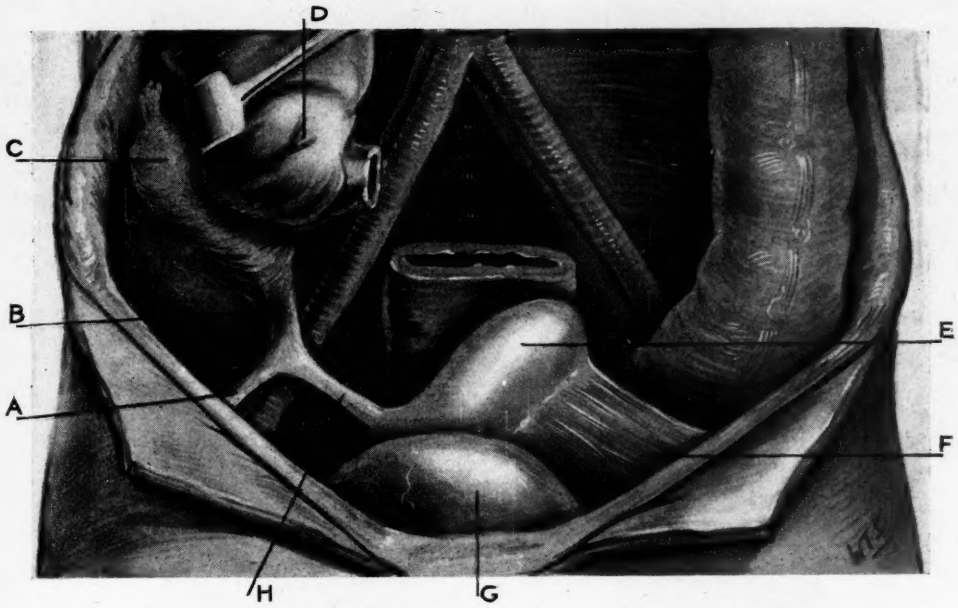


FIG. 110.—General position of pelvic viscera as seen at operation. A, Right round ligament; B, Ligament of right ovary; C, Right ovary; D, Cæcum; E, Left cornu of uterus; F, Left broad ligament; G, Bladder; H, Right cornu of uterus.

had to be excised with it. The patient had an uneventful convalescence. The attacks of pain did not recur.

In the normal course of events the ovary develops in the lower dorsal region. It possesses a mesovarium, and lies close to the Fallopian tube and mesosalpinx; the mesovarium and mesosalpinx are attached to the posterior abdominal wall by a common genital mesentery. The ovary reaches the iliac fossa in the fifth month of gestation, the brim of the pelvis at full term, and its normal position in the 'ovarian triangle' after birth. During its descent the mesovarium, the mesosalpinx, and the common genital mesentery join to form the broad ligament. It is obvious that in the case of non-descent the broad ligament cannot be formed. This was well illustrated in the case described.

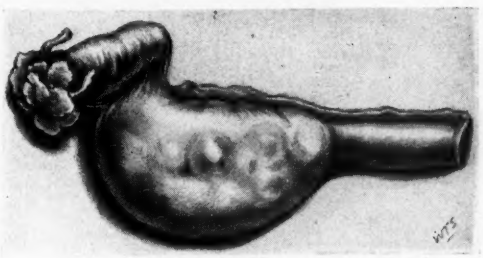


FIG. 111.—Ectopic ovary.

Fig. 110 shows the general position of the pelvic viscera as observed at operation. *Fig.* 111 represents the ovary as it appeared after removal. Microscopical sections of the cut end of the specimen show unstriped muscle, indistinguishable from that found in the normal uterus.

A CASE OF HEART SUTURE.

By HAMILTON DRUMMOND, Newcastle-upon-Tyne.

J. W. S., age 25, a sailor, was admitted to the Royal Victoria Infirmary at 7 p.m. on July 8, 1924, with the following history: Owing to a disappointment in a love affair, on the day of admission at 6 p.m. he attempted to take his life by stabbing himself in the heart with a penknife. He immediately collapsed in the street, and was shortly afterwards seen by Dr. Eric Dagger, who found him lying on the pavement drunk and with a considerable amount of blood on his clothing. He was immediately despatched in an ambulance to the Infirmary, a distance of about two miles.

On admission he looked pallid and was under the influence of alcohol; his general condition was fairly good, pulse 80 and regular, temperature

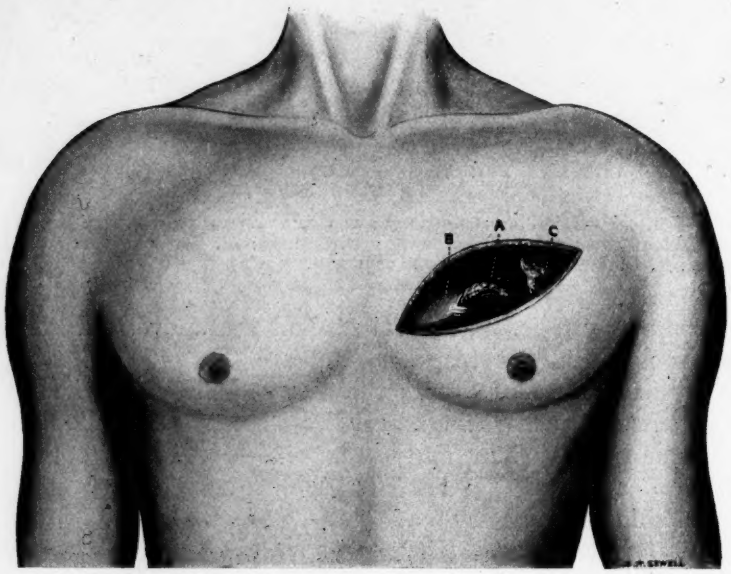


Fig. 112.—Shows condition found at operation and the incision employed—excision of third rib cartilage with portion of adjacent rib. A, Portion of left auricle protruding through pericardium; B, Pericardium; C, Lung.

normal. His respirations were not increased, nor had he any dyspnœa. There was a small stab wound situated in the second intercostal space on the left side, ¾ in. long and 1½ in. from the sternum. There was not any hæmorrhage from the wound, and it admitted a probe for about 1 in., the pectoral muscle being well developed. There was no increased cardiac dullness suggestive of pericardial effusion.

On account of the absence of grave symptoms the wound was dressed, and the likelihood of any serious injury was not entertained. About an hour later the patient became restless and complained of difficulty in breathing.

He was more pallid, and preferred to be in a half-sitting posture on his right side. Dyspnœa became rapidly worse, respiration was rapid and shallow, and his pulse rose to 110. He was then seen by Dr. Horsley Drummond, who found dullness in the left chest up to the level of the sixth rib; there was still no increased dullness of the pericardium, but the heart was displaced to the right. Immediate operation was advised, as it was now clear that he was suffering from a progressive hæmorrhage into the left pleural cavity.

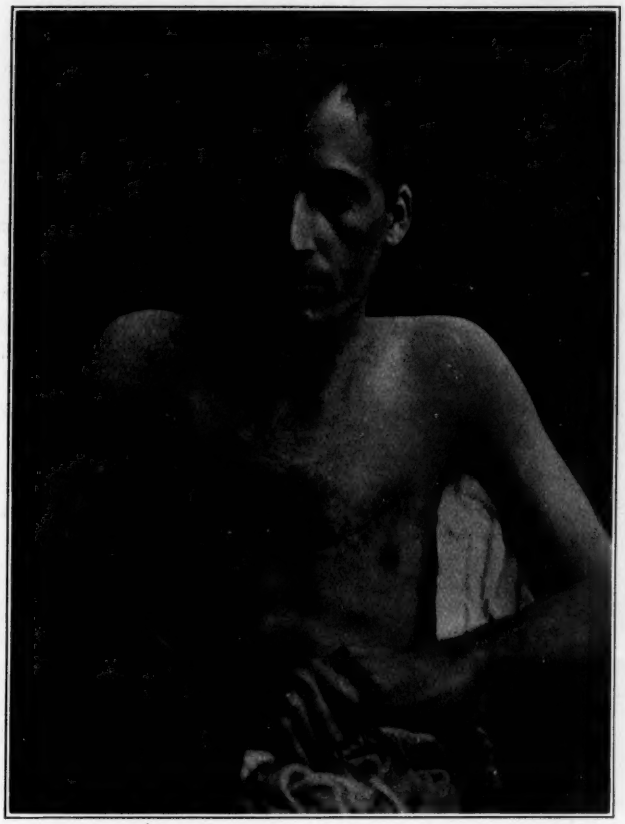


FIG. 113.—Shows line of the incision, taken ten weeks after the injury, shortly before leaving hospital.

It was impossible to carry out an operation with a local anæsthetic because he was so restless and continually throwing himself about in his attempts to breathe more freely. Open ether was given, and the wound explored by an incision 6 in. in length along the third rib cartilage, splitting the pectoral muscle and extending along the third rib (*Figs.* 112 and 113). The costal cartilage and one inch of the rib were excised. The left pleura was freely opened for the length of the incision, the anterior margin of the left lung was pulled up, and the lung examined; it was uninjured. Deeper inspection showed, at the base of the pericardium on the left side, a hole ½ in. long through which the left auricular appendix protruded, and from it there

was a continuous flow of blood. The wound in the auricle was practically at its tip (*Fig.* 114), and on catching the edges with fine dissecting forceps a rush of blood escaped from the heart.

The auricular wound was closed with catgut sutures; but this was a difficult procedure owing to the thinness of the wall of the auricular appendix, which at the point of injury did not appear to be thicker than a child's omentum. After three interrupted catgut sutures were introduced the hæmorrhage was controlled. Another difficulty in the closure of the auricle was caused by the continual welling-up of blood from the left pleural cavity. The major part of the blood in the pleura was mopped out—probably 60 oz.—and the pleural cavity was closed completely without drain by a row of interrupted catgut sutures for the pleura and a second layer for the pectoral muscles.

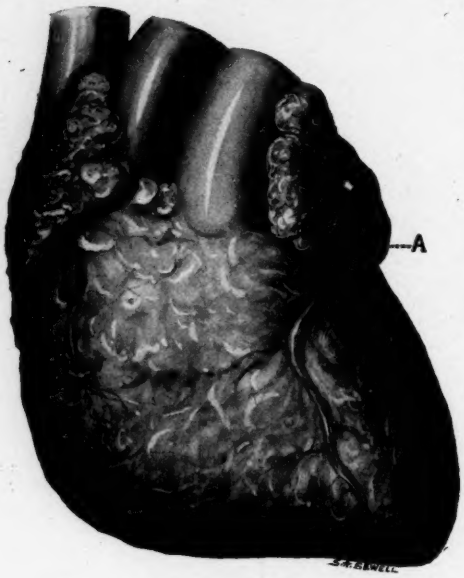


FIG. 114.—Drawing of a normal heart.
A shows position of the wound in left auricle.

The patient greatly improved in condition after the operation, and was no longer restless. On the following day his general condition was fair; respirations were rapid—68, largely due to a pneumothorax; temperature 100°, pulse 116.

On July 11 he was much improved, respirations 56, temperature 99·2°, and pulse 108, though there was a good deal of expectoration, and signs of considerable pleural effusion were present. The following day he was about the same; the pleural effusion appeared to be diminishing. Steady improvement occurred until the 22nd, fourteen days after operation, when his temperature rose and dyspnœa was more marked. Twelve ounces of blood-stained serum were removed from the pleural cavity by aspiration, and on bacteriological examination it proved to be sterile. For several days he complained of severe precordial pain, and this was accompanied by vomiting. A considerable amount of consolidation of the left lung was present at the base, and there was rusty sputum.

An empyema of the left chest developed, which was aspirated on Aug. 19, and operated upon under a local anæsthetic. A small portion of rib was resected and the chest drained. The pus on examination showed pneumococci and staphylococci. After this his recovery was uninterrupted, and he left hospital healed and well on Sept. 29.

Since leaving hospital, patient has been seen from time to time and is in excellent health. (February, 1925.)

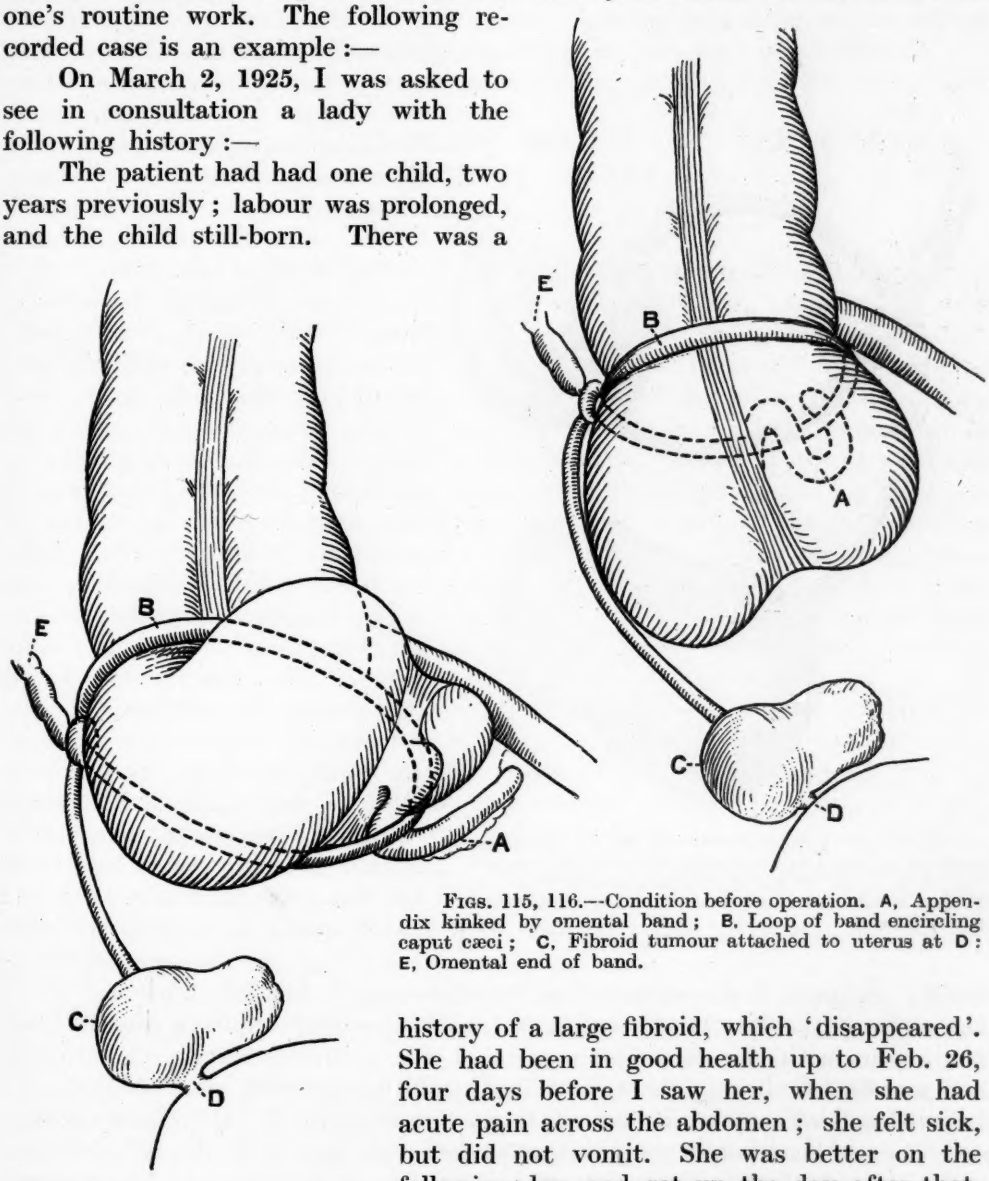
CASE OF SNARING OF THE CAPUT CÆCI AND APPENDIX BY AN OMENTAL BAND.

By Sir HUGH M. RIGBY, K.C.V.O., London.

Surgery of the abdomen owes much of its interest to those unexpected and almost dramatic findings which are occasionally met with in the course of one's routine work. The following recorded case is an example :—

On March 2, 1925, I was asked to see in consultation a lady with the following history :—

The patient had had one child, two years previously ; labour was prolonged, and the child still-born. There was a history of a large fibroid, which 'disappeared'. She had been in good health up to Feb. 26, four days before I saw her, when she had acute pain across the abdomen ; she felt sick, but did not vomit. She was better on the following day, and got up the day after that, though she felt pain in the right side. Three days after the onset of the attack, she was seen by her doctor : there was then no rise of temperature ;



Figs. 115, 116.—Condition before operation. A, Appendix kinked by omental band ; B, Loop of band encircling caput cæci ; C, Fibroid tumour attached to uterus at D : E, Omental end of band.

the pulse-rate was 70. Local tenderness was noted in the abdomen, and some rigidity of the muscles; pelvic examination was negative. The monthly period coincided with the attack, and the significance of this was considered. Discomfort was still present. When I saw her, the temperature was normal and the pulse quiet. On pressure over the ileocæcal region, distinct tenderness was felt, and some pain was also noted on pressure to the left of the mid-line. A diagnosis of appendicitis was made and operation was advised.

Operation, March 6, 1925.—Under anæsthesia, an ill-defined lump could be felt in the right iliac region.

The abdomen was opened by a right paramedian incision. The cæcum was at once exposed to view, and the following very unusual condition was disclosed (*Figs.* 115 and 116). Surrounding the caput cæci was seen a string-like band of deep maroon colour, adherent to the cæcal wall at the outer side; here, a knot could be seen, and, from this knot, the band passed downwards over the brim of the true pelvis. The cæcum was somewhat mobile; on lifting it up, the band was seen to pass across the appendix, near its attachment. At the point of crossing, a deeply injected groove was seen, so that the appendix was acutely kinked; the distal part was a little distended, but of good colour, and the mesentery apparently was not congested. On tracing the band downwards, it was found to be attached to a smooth tumour in the right side of the pelvis, which at first was thought to be an ovarian cyst. The band was ligatured at the pelvic brim and divided; the knot was then untwisted, and the part of the cord encircling the caput cæci was freed; in parts it was adherent, but in the main it could be separated without difficulty. The band was then traced upwards, and was found to be continuous with the right free margin of the great omentum. The upper end was ligatured and cut across. The appendix was then removed, and the cæcum and lower part of the small gut returned to the abdominal cavity.

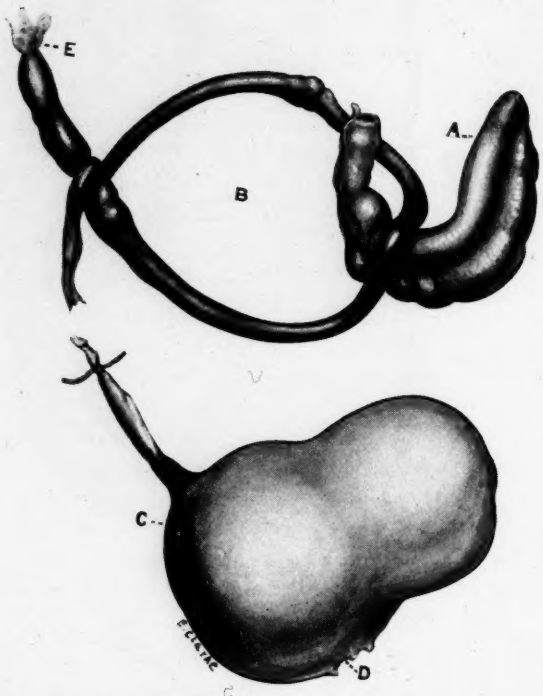


Fig. 117.—Specimen removed at operation and replaced in position. A, Appendix kinked by omental band; B, Loop of band encircling caput cæci; C, Fibroid tumour attached to uterus at D; E, Omental end of band.

The pelvic tumour was next examined: it proved to be a subserous, pedunculated fibroid attached to the right side of the fundus of the uterus by a short pedicle; the latter was ligatured and the tumour delivered from the pelvis. The caput cæci was not engorged, and, although fairly tightly

constricted by the band, showed no appreciable damage to its coats at the site of the constriction. The abdominal wound was then closed.

Immediately after the operation, a drawing was made, the parts removed being reproduced as shown in *Fig.* 117; the loop made by the band is just as it was found, and the appendix and tumour are replaced in their original position. My secretary, Miss Ethelwyn Clarke, has made an exact picture.

The knot formed by the band was produced by a double twist of the loop on its axis. Presumably the band was formed at or after the pregnancy occurring two years previously, but how the caput cæci became involved, and how the double twist occurred, must remain a matter of speculation.

TWO CASES OF FOREIGN BODIES IN THE GASTRO-INTESTINAL TRACT.

By WILMOT ADAMS, Penang.

1. **Cast of Vegetable Material Simulating Carcinoma of the Stomach.**—A Chinese male, age 37, was admitted under my care on Nov. 5, 1921, complaining of persistent vomiting, loss of weight, and gastric discomfort. These symptoms had been present for about five months. No history of hæmatemesis or melæna. He was markedly wasted, but otherwise his general condition was fairly good. In the epigastric region was a hard tumour which corresponded roughly to the shape of the stomach. No peristalsis was elicited, there was no free fluid in the peritoneal cavity, and the liver was not enlarged.

I considered it to be an advanced case of carcinoma of the stomach, and that on account of its extent even a palliative operation was out of the question. This was explained to the patient, who begged me to explore in order to make perfectly certain. This was done on Nov. 8, under local anæsthesia. Local infiltration of the abdominal wall with ½ per cent novocain was the method employed.

On opening the abdomen and palpating the stomach, it immediately became obvious that the tumour lay within the stomach, the walls of which moved freely over it. The stomach was delivered and packed off, and an incision 5 in. long made in the long axis midway between the two curvatures. The foreign body was removed, and proved to be a cast of the stomach composed of some vegetable material. The pylorus was patent, and there was no sign of ulcer or neoplasm. The incision in the stomach was closed in two layers in the usual way, the packing removed, and the abdominal wound sutured in layers.

On examination, the cast was found to be composed of pumpkin. There was no macroscopic evidence of any other foreign body forming a nucleus. Recovery was uneventful.

2. **Richter's Hernia-scrotal Abscess Containing Fruit Stones.**—A Chinese male, age 60, was transferred to my care from the Pauper Hospital on July 7, 1923, for operation for strangulated inguinal hernia. He stated he had had the hernia for eight years, but that during the last two months it had been irreducible and painful. The hernia appeared to be a typical strangulated inguinal one. The patient's general condition was excellent.

There was no abdominal distention or other evidence of general peritonitis or mechanical obstruction. He was quite positive that his bowels had moved that morning, and he had only come to hospital on account of the pain.

Under local anæsthesia (infiltration with ½ per cent novocain) herniotomy was performed at once. The sac contained a loop of small intestine, the apex of which was firmly adherent to the lower end thereof. In endeavouring to separate it I opened into an abscess containing about 4 oz. of foul-smelling pus. On exploring the abscess cavity, I found it contained three hard foreign bodies, which on opening up further proved to be three rambutan stones. They are about the size of plum stones. Investigating further I found that the gut was perforated, and in such a way had compression been exerted that the portion below the point of strangulation (the external ring) had been converted into a funnel-shaped process, the wide end of which opened into the abscess cavity, but the gut was not completely occluded. This portion was markedly hypertrophied. The mucosa was thick and rugose, and the rest of the wall almost fibrous in consistency.

It was obviously essential to remove this portion, and it was clear that after doing so the lumen of the gut would be too narrow for safety if simply local removal was performed. I therefore resected 8 in. of gut, including the strangulated portion, and made an end-to-end anastomosis with clamps in the usual manner. The gut was returned, and the sac cleared up to the internal ring and removed, but the neck of the sac was not tied off. Two catgut sutures were passed through the neck of the sac and made to interlock, but were left untied. A short rubber tube was passed through the internal ring down to the site of the anastomosis. The skin wound was loosely sutured, and a tube put in at the lower end.

The patient was kept on dilute brandy and water by mouth, and rectal salines, for four days. The bowels moved naturally after thirty-six hours. An enema was given on the fourth day with a good result. On the fifth day, no leak from the anastomosis having occurred, the tube in the internal ring was removed and the neck of the sac tied off. Subsequent recovery was uneventful, except for inevitable suppuration in the wound, which took five weeks to heal. On account of this, and the age of the patient, it did not appear advisable to attempt anything further in the nature of a radical cure. He was instructed to report in three months' time. or if any swelling reappeared before that date.

SARCOMA OF THE RENAL PELVIS, ASSOCIATED WITH HYDRONEPHROSIS.

By F. G. RALPHS, Dukinfield.

A woman, age 39, was referred to the Ashton-under-Lyne Infirmary with the diagnosis 'twisted pedicle of ovarian cyst'. On admission, her general condition was one of collapse, with a small pulse of 130 and a subnormal temperature. Two days previously she had first noticed a swelling on the right side of the abdomen.

On Examination.—A circumscribed mass was revealed to the right of the umbilicus, and continuous above with a large elastic tumour filling the right hypochondriac and lumbar regions. The tumour showed slight lateral mobility, and was not tender to palpation; a thrill could be elicited across its lower border.

Prior to the appearance of the swelling, she had experienced no discomfort save an occasional aching pain in the right loin. There was no history of hæmaturia.

Operation.—Vaginal examination having excluded the pelvis from involvement, laparotomy through a right paramedian incision was performed. A large bluish and cystic tumour presented, bulging forward the posterior peritoneum and occupying a large extent of the retroperitoneal space on the right side. The cæcum and ascending colon were adherent to the medial aspect of the tumour; the appendix stretched transversely across its lower pole. The texture of the tumour varied appreciably, for whereas the lower portion was cystic and elastic to the touch, the upper portion was reniform and of firm consistence. The whole mass, enclosed in a thick fibrous capsule, appeared to be a large hydronephrotic kidney with a solid growth at the upper pole. Separation of the proximal colon by gauze stripping, and free incision of the peritoneum and fibrous capsule, permitted of enucleation of the tumour from its retroperitoneal bed. There was free oozing at this stage, controlled by a big gauze pack. Access to the renal pedicle was barred by the formidable size of the mass, which was diminished by tapping the cystic lower portion. About one pint of blood and clot escaped, and facilitated exposure of the pedicle. This was thick and adherent to the vena cava. During the separation of these adhesions the patient became very collapsed, and therefore nephrectomy was rapidly completed. The tumour, on removal, weighed 28½ oz.

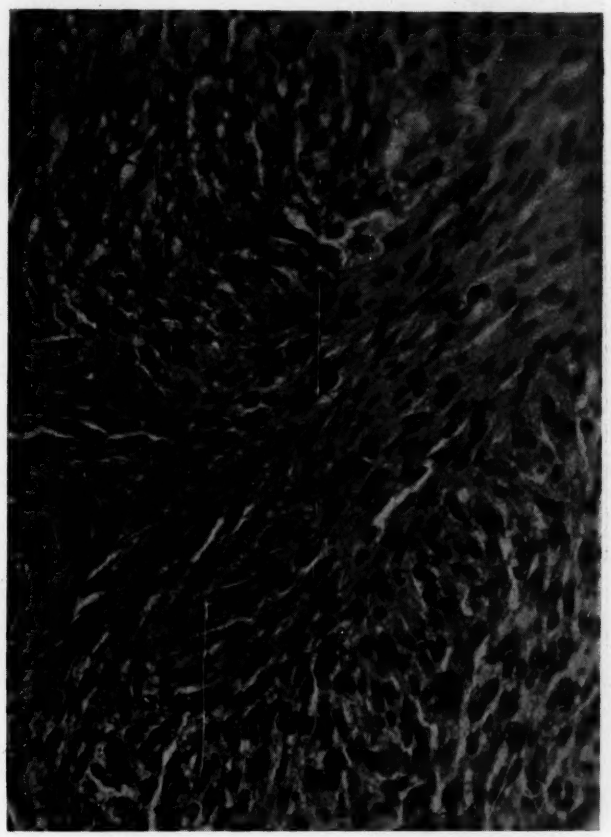


Fig. 118.—High-power view, showing spindle cells.

Of necessity, the after-history is brief, for the patient died a few minutes after the operation. Her pulse had failed during the isolation and separation of the renal pedicle from the vena cava. Some degree of traction was unavoidable, and doubtless contributed to the fatal result.

PATHOLOGICAL FINDINGS.—To the naked eye, the tumour presented two strongly contrasting parts—an upper, of soft, diffluent, brain-like tissue encased in a stout fibrous capsule, and a lower, composed of a large hydronephrotic sac, into which a copious hæmorrhage had occurred. It is probable that the development of the hydronephrosis was secondary to a gradual obstruction of the renal pelvis by a growth therein, for such was the origin of the growth removed, according to the pathological report appended. I am indebted for it to the kindness of Dr. Powell White, of the Cancer Research Laboratories of the University of Manchester.

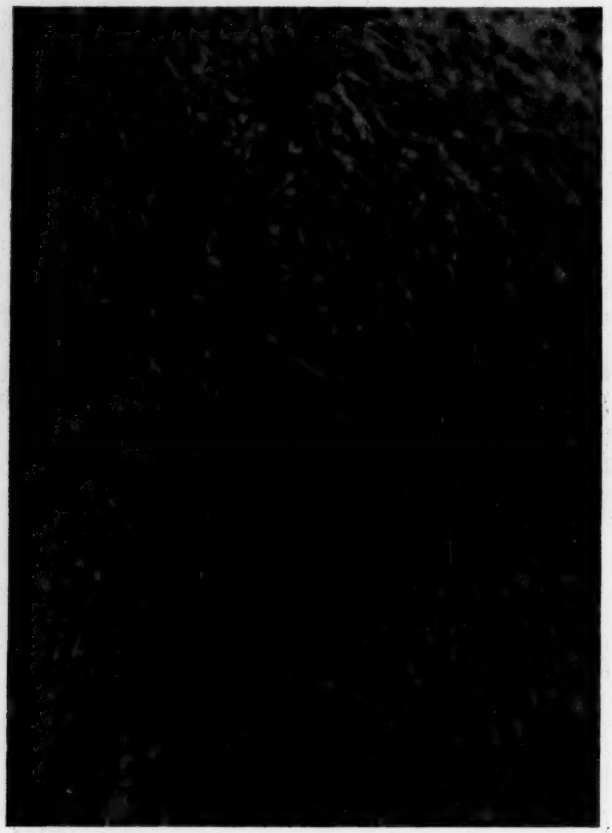


FIG. 119.—Low-power view through solid portion of growth.

PATHOLOGICAL REPORT.—"The kidney tumour is a spindle-celled sarcoma. It shows some mucoid degeneration in places, and a considerable amount of necrosis and hæmorrhage. I should think it originated in the connective tissue of the renal pelvis. I was able to find some small remains of kidney tissue."

OBSERVATIONS.—Malignant tumour of the renal pelvis is an uncommon type of growth, to judge from the rarity of its occurrence in surgical literature. In this example, there seems to have been a striking absence of symptoms until the stage of degeneration and necrosis had been reached.

REVIEWS AND NOTICES OF BOOKS.

Papers and Addresses in Surgery (Selected and Revised). By R. HAMILTON RUSSELL, F.R.C.S., Associate of King's College London; Consulting Surgeon to the Alfred Hospital, the Children's Hospital, the Victorian Eye and Ear Hospital, and the Queen Victoria Hospital for Women and Children, Melbourne. Demy 8vo. Pp. 452, illustrated. 1923. Melbourne: Allan Grant.

SURGEONS who have been interested in the writings of R. Hamilton Russell—and they exist all over the world—as well as his friends and former students, will be glad to have his more important papers collected into one volume. In the preface the author states that the publication would never have seen the light of day but for the knowledge that the task was about to be undertaken by others. We can be grateful that this induced him to edit the papers himself.

Mr. Russell is a surgeon who has never been satisfied to follow text-book procedures unquestioningly. Every case has come to him as a problem in principles. Very early in his practice at the Children's Hospital, Melbourne (*Lancet*, 1899) there appeared to him to be flaws in the accepted etiology and pathology of indirect inguinal hernia. This doubt resulted in his belief in a congenital sac as the sole cause of indirect inguinal hernia. Investigations in the post-mortem room (p. 123) lent colour to this theory to the extent that a sac was found to be present in a high percentage of individuals who had not been the subject of hernia. The only proof of the theory which seemed possible was to put it to the operative test—to remove the sac at its origin, not near its origin—and to omit all procedures usually considered necessary for strengthening the abdominal wall. His theory has been put to this severe test in that for many years he, his colleagues, and successors have abandoned any other procedure beyond high ligature of the sac in this type of hernia, except where advancing years or the size of the hernia had weakened the anatomical structures surrounding the neck of the sac.

Mr. Russell's theory of the causation of properitoneal and interstitial hernia will be read again with interest. Everyone does not yet agree with him as regards the saccular origin of femoral hernia, but all surgeons will, after reading the chapter, be alert to the possibilities, and on the look-out for evidence. The reviewer had the good fortune to see recently a large femoral hernia in which the sac descended between the femoral artery and vein—apparently a congenital sac caught up by the growing limb bud in fœtal life, as Mr. Russell suggests. There will also be differences of opinion as regards the operative procedure to be followed in femoral hernia. The high operation is being performed more and more, and, as far as can be judged from the follow-up department in one hospital, with far fewer recurrences.

The chapters on fractures—simple and those implicating joints—are eminently sane, and his scathing criticism of passive motion is well merited; the simplicity of the methods advocated, and the unremitting personal attention of the surgeon, are two points well worthy of attention.

Intractable stricture of the urethra often drives surgeon and patient to despair. Mr. Russell's idea of dealing with the very old man (p. 295) by "deliberately converting the subject of intractable stricture into a case of hypospadias", with its happy result, was an inspiration. Treatment of difficult strictures by excision has been practised, but hitherto the urethra has been completed by accurate suturing. The results were such that the methods had fallen into disuse. Realizing that if the urethra be slit up ventrally for any length and left open, perfect repair and function will result, Mr. Russell has devised an operation by which the urethra is slit up in this fashion, making the tube of mucous membrane into a ribbon. The

stricture is excised, and the ends of the ribbon are united by stitches and left as a ribbon, no attempt being made to convert it into a tube. The absolutely free drainage ensures perfect healing of the mucous membrane; the tube reforms itself as the wound heals, and, as the exciting cause and the cicatricial tissue have both gone, the urethra remains patent and soft. Details of the operation, with many illustrative cases and the late results, are given.

Two articles are noteworthy in that procedures which at the time were unique have in later years become common practice. In 1903 Mr. Russell freely opened a chest under general anæsthesia in order to remove a large-headed pin from a bronchus; and in 1907, when operating upon a patient very ill with an infected hydatid cyst of the liver, he evacuated the cyst and its contents, cleansed the cavity, filled it with saline solution, accurately sutured it, and then completely closed the abdomen. Nowadays pleural cavities are opened with impunity, and surgeons have learned that the abdominal cavity can deal with some types of infected material with safety; but at that period both procedures required vision and courage.

As a teacher one realizes that Mr. Russell loved his students, and, by his own life and attitude towards his profession, ever kept before them a very high ideal of the calling they had chosen. The chapter with which the volume opens, the Presidential address to the Section of Surgery, Australasian Medical Congress, Auckland, N.Z., in February, 1924, is charged with reverence and affection for Lord Lister, Mr. Russell's chief when a student and house surgeon at King's College Hospital; and, just as much of Lister's mind and practice live in Mr. Russell, so are the best traditions passed on again by Mr. Russell to the next generation. The surgeon who compels thought, and whom his students and associates love, achieves greatly more than the acceptance or non-acceptance of his own theories.

Surgical Operations: A Text-book for Nurses. By E. W. Hey Groves, M.D., B.Sc., M.S., F.R.C.S., Surgeon Bristol General Hospital, Professor of Surgery, Bristol University. Second edition. Royal 8vo. Pp. 255, illustrated. 1925. London: Humphrey Milford, Oxford Medical Publications. 21s. net.

That this unique work was long overdue all who read the first edition must have felt, and that it has come to stay is happily assured by the arrival of a second edition. Whether approval is universal or no, among those who care for the sick, the modern probationer with an average secondary school education will and should no longer be satisfied with 'blind' nursing. As in others, so in her profession, science is invading, and the nurse blends tireless devotion to her patient and the doctor's instructions with a desire to know 'what was done in the theatre' and 'why'. Thus she gains an intelligent interest in her work, and becomes a more harmonious medium between the surgeon and patient. Her cardinal virtue of constant loving care can only be enhanced by an understanding mind.

To represent the vast range of modern operations in a brief, simple, and picturesque form is a bold venture, but the reputation of the author of *Surgical Operations* is commensurate with it. There is an admirable selection of operations, and the descriptive paragraphs contain the 'pith of the matter', whilst the abundant illustrations make a feature that cannot be over-praised. It is a pioneer work handled in a masterly fashion, and it has secured a prominent place in surgical literature which a few friendly criticisms will not impair.

In the opening chapter the text would be helped by illustrations of a modern operating theatre with operation proceeding, of a surgeon attired, and an operating table. The Trendelenburg position might well be figured. With nurses as readers the notes on the pre- and post-operative care of cases are specially welcome. They might be amplified in the chapters on tongue and pelvic operations, and the need for an empty bladder in pelvic cases deserves a note. One looks in vain for a reference to perineorrhaphy.

The illustration of instruments is a distinctive boon to the student, but space could be saved by not depicting many of them twice, i.e., in the text and in the appendix, which would then be available for some common examples at present omitted, e.g., proctoscope, various scissors, mouth gags, aural specula, etc. The

alphabetical arrangement of instruments seems no advantage over the common commercial custom of listing them in regional sets. With the increased delicacy and complexity of instruments it would be as well to add a note of warning to those in charge of them, indicating that it is not enough to assemble them only, but that their constituent parts must fit and their efficiency be tested before they are offered to the surgeon (and the patient!) for use.

These are a few trifling corrigenda, and one slip that certainly calls for remark is the description of the myxœdematous patient as having "greasy and perspiring skin".

In concluding one's remarks on *Surgical Operations*, one may say no nurse should be without it, and the student will warmly welcome so simple and comprehensive a portrayal of this fascinating subject when he embarks on the study of surgery.

Surgical Pathology. By JOSEPH MCFARLAND, M.D., Sc.D., Professor of Pathology in the Medical Department of the University of Pennsylvania. Royal 8vo. Pp. 701 + xiv, with 435 illustrations. 1924. London: H. K. Lewis & Co. Ltd. Price £2 2s.

THE outlook of the author is epitomized in the first sentence of the preface, in which he tells us that "surgical pathology is not a separate subject, but merely the bringing together and emphasizing of those aspects of pathology that have been found to be of particular interest and importance to surgeons". The attempt to attain this object has resulted in this book, in which a great deal of useful information is to be found. Nevertheless, it is often disappointing, and much that would be of great interest and value to surgeons is not to be found in its pages.

The work is divided into three sections: (1) Congenital conditions of surgical interest; (2) Tumours; (3) Special pathology. Instead of starting with any general description of the pathological processes, that knowledge is assumed, and the author plunges directly into a detailed consideration of congenital conditions. This forms an interesting section of 202 pages which have been allotted from a total of 656. The classification adopted is very practical and useful, and the table of contents is in itself a synopsis of all the congenital anomalies which are ever likely to be met with. A good subsection is that on the persistence of the omphalomesenteric duct —Meckel's diverticulum—and it is well illustrated by diagrammatic representations of practically all the conditions found. Deformities like club-foot, club-hand, torticollis, congenital dislocation of the hip, etc., are also dealt with, but the author has nothing new or suggestive to say about them.

In Section II, devoted to the consideration of tumours, the author makes some pertinent remarks on the microscopic examination of tumours, and the relationship and mutual responsibility of the surgeon and of the pathologist in these matters. The classification of tumours is always difficult, and we are told that in the present uncertain state of our knowledge no classification can be regarded as satisfactory, but that the best is that of Adami, which is adopted in this work.

In dealing with the fibromas, we are reminded that the microscope is not an infallible guide in determining the malignancy or benignancy (*sic*) of tumours of this class. This is a point frequently emphasized in connection with many of the tumours, and all practical surgeons must find themselves in agreement.

Angiomas which give rise to secondary deposits in the viscera are described and figured. Myelomas are placed among the sarcomas, and the author also speaks of pseudo-sarcoma gigantocellulare in this connection. Altogether the paragraphs devoted to this subject do not tend to clarify the difficulties surrounding this type of new growth. Dealing with cysts, the author recognizes the difficulty of classification, and naïvely remarks that "the following tabulation seems to afford a convenient *approach* to the subject".

Section III deals with special pathology, or as we would say, regional pathology. The breast is very fully dealt with, and Bloodgood is freely quoted. Many technical points are considered as they would be in a text-book on surgery.

For those who have devoted much time to the study of naked-eye pathology, and who have insisted on its importance, it is refreshing to read, "Cancer is so

distinctive in its appearance that it ought to be recognized by the naked eye without difficulty". And again, "Cancer was never found by microscopic examination where it was not suspected from what the finger and naked eye had found, though occasionally what the eye and finger thought to be cancer was shown by the microscope to be something else". After these statements it is not surprising to find that the author does not place much reliance on the frozen section for diagnosis. A good deal of space is given to the consideration of sarcoma of the breast, and many clinical details are incorporated. Dealing with Paget's disease of the nipple, McFarland joins issue with Sampson Handley and considers that it is primarily a skin affection.

In the urogenital section, enlargement of the prostate receives much attention, and again many clinical points are dealt with. The author favours an inflammatory origin. In discussing ascending ureteral infection, no mention is made of Bond's careful researches on the ascending mucous currents, nor is this matter referred to elsewhere. The statement that sarcoma of the prostate is not recognized in adults is not in accordance with the recorded facts. In dealing with vesical papilloma, the author properly emphasizes the difficulty of deciding on its malignant nature or otherwise from a microscopic examination of a small portion—oftener obtained from the summit of the growth than from its base.

The gastric section is disappointing, and the question of the relationship of chronic ulceration to cancer is apparently evaded. In dealing with the pancreatic affections, inflammatory effusions into the lesser sac are not mentioned, and evidently the classical paper of Jordan Lloyd has been overlooked. The author has nothing new to say about the always interesting problem of intussusception, and the not infrequent inversion of Meckel's diverticulum is not mentioned.

The book concludes with a few pages devoted to the bones and joints.

There are 435 illustrations, most of which have been culled from other works. On the whole they are well selected, and have often been improved by being redrawn. It is pleasing to note that in every case the source of the borrowed illustrations has been properly acknowledged. There is also a useful bibliographic index, but a few inexcusable mistakes are obvious—Kelley for H. A. Kelly, Sill for Still, Shattruck, rendered elsewhere Shattuck, for Shattock, etc. There are also a good few misprints, and many peculiarities in spelling; some of these may only be Americanisms in common use, but they are not pretty words, and never likely to be acceptable to readers on this side.

This publication is not a text-book for students, nor will it replace any of the few existing works on the subject; nevertheless it contains much that is of interest to the practical surgeon, and should certainly be available for reference.

On the Breast. By DUNCAN FITZWILLIAMS, C.M.G., M.D., F.R.C.S., Surgeon in Charge of Out-patients and Lecturer on Operative Surgery to St. Mary's Hospital. Royal 8vo. Pp. 440 xxv, with 166 illustrations and two plates. 1924. London: Wm. Heinemann. 30s. net.

THIS book is one of great practical importance: it contains a careful first-hand clinical account of the diseases and abnormalities of the breast. Its most valuable feature is the actual case history given of each typical condition. It would be easy to find fault with the book, but difficult to produce a better one. The description of microscopical anatomy, pathological theories, and the less direct methods of treatment such as radium is inferior to the clinical section of the work.

Mr. Fitzwilliams strongly opposes Handley's permeation theory, but his criticisms are based on general considerations rather than upon a study of morbid histology. He accepts the work of Lenthal Cheatle in its entirety, without giving any very clear explanation of its purport.

The numerous illustrations are rather crude and diagrammatic, a large proportion being borrowed from other sources.

The outstanding merit of the book is its clear account of the clinical features of various diseases, and for this purpose we think it will establish a place as a book of reference.

Dislocations and Joint-fractures. By FREDERIC J. COTTON, A.M., M.D., F.A.C.S., Surgeon to the Boston City Hospital; Associate in Surgery, Harvard Medical School. Second edition. Pp. 745, with 1393 illustrations. 1924. London and Philadelphia: W. B. Saunders Co. 50s. net.

THIS second edition of a work which received full recognition on its first appearance is of great value. It has increased in size, it includes experience gained in the war, and it represents five further years of experience. Its value consists in the fact that it represents the personal observation and experience of one who has made very careful records. The illustrations are for the most part personal sketches or drawings by the author; and these, too, serve to keep the reader in actual touch with practical facts as they were observed at the time. For the most part the book consists in a minute description of all varieties of injuries near the joints, together with the symptoms and treatment. Details of treatment by manipulation or by splinting are very full, whilst details of operative treatment are conspicuously absent.

It will always form a valuable book of reference, although it will often have to be supplemented by a further work on operative surgery. For example, many pages are given to the description of the fractures of the lower end of the humerus; but one looks in vain for guidance in the treatment of a T fracture into the elbow when non-operative methods have failed. Similarly, the discussion of dislocation of the hip is given in great detail up to the point when manipulation has failed to reduce, and then we are left without guidance or advice.

Lumbar Puncture: its Anatomical and Physiological Relations, Technique, etc. With an Appendix on Encephalography and Puncture of the Cistern. By MARTIN PAPPENHEIM, M.D., Professor at the University of Vienna. Translated by George Caffrey. Demy 8vo. Pp. 248, illustrated. 1925. London: Bale, Sons & Danielsson Ltd. 15s. net.

THIS is a translation of the 1922 German edition, with a new appendix on encephalography and cistern puncture, and the addition of a few paragraphs on recent work. The majority of the book is taken up with details of the technique of lumbar puncture and of the examination of the cerebrospinal fluid, but thirty pages are devoted to some points of diagnostic value, and thirteen to "the therapeutical applications of lumbar puncture", chiefly in the treatment of syphilitic nervous diseases.

The arrangement of the book follows a plan common in German medical literature but less favoured in this country, viz., a complete absence of all sub-headings and italics, so that we often pass from one subject to another without noticing it. This is especially inconvenient in the chapters on technique, as the laboratory worker will have difficulty in finding any particular technical point in which he is interested, and the clinician will scarcely be tempted to sift the abundant chaff of laboratory detail for the few grains of clinical application which may be found among it.

In the details of the operation of lumbar puncture the clinician will find much that is useful, and also much with which he will disagree, as for example the recommendation that the needle should be made of steel, nickel-plated. "If a needle should break, it is usually easy to extract it with forceps; sometimes a skin incision is necessary."

The chapter on the diagnostic import of lumbar puncture will be of greater interest; as much space is devoted in it to the distinction between different forms of meningitis, *purulenta infectiosa*, *purulenta aseptica*, *concomitans*, *serosa*, and *meningismus*. It is not easy to obtain from it a clear perception of the meaning of these terms, and some confusion is introduced by such statements as that "*meningitis serosa* is characterized by clear, faintly turbid spinal fluid". The author's opinion that "in general the prognosis is comparatively favourable for an affection with turbid but sterile spinal fluid" will find general acceptance. Very little is said about the chemistry of the fluid in these conditions, beyond the statement that the chlorides are greatly reduced in tuberculous meningitis. Nonne's 'compression syndrome' and its confirmation by the 'Queckenstedt symptom' receive some attention, and the remainder of the chapter deals with the diagnosis of neurosyphilis.

In the appendix on encephalography, the insufflation of air by the lumbar route is fully dealt with, but Dandy's ventriculography is barely mentioned; in that on cistern puncture the names of Ayer and his co-worders do not appear, nor is any mention made of the injection of lipiodol; and in the bibliography, eight pages long, the only recent Anglo-saxon paper referred to is that of Dandy. Such wholesale exclusion of all but Teutonic literature is excusable in an Austrian publication, but might have been remedied in an English translation. The translator has followed the German idiom too closely for clearness, and in some places it is quite impossible to understand the author's meaning. Several decimal points are misplaced, mistranslations such as 'inspissator' for a thermostat at blood heat (Wassermann bath) are not uncommon, and words unfamiliar to English readers, such as 're-infundibulated', often occur. The book would have been improved by freer translation and more careful editing.

The Advance of Orthopædic Surgery. By A. H. TUBBY, C.B., C.M.G., M.S., F.R.C.S., F.S.A., Consulting Surgeon to Westminster, Royal National Orthopædic, Evelina, and Christ's Hospitals, etc. Reprinted from the *Clinical Journal*. Crown 8vo. Pp. xii + 144, with 31 illustrations. 1924. London: H. K. Lewis & Co. Ltd. 7s. 6d. net.

THIS little book forms light and pleasant reading, and is at the same time a useful compendium of recent work, selected, perhaps, rather at random, and not really strictly confined to the limited period since 1912 that the author mentions in his first chapter. The short annotations on congenital deformities of the spine and spondylolisthesis and those on growth deformities (Legg's, Kohler's, Osgood-Schlatter, and Konig's diseases) are of special interest. In the chapter on static and postural deformities, Mr. Tubby's views on the importance of asymmetry in scoliosis are described at length; it cannot, however, be said that these are generally accepted by orthopædic surgeons, and this chapter should be read in a critical spirit. The physiological problem of the nature and innervation of plastic tonus and its importance in postural deformities is omitted; this applies also to the physiology of spastic conditions and the question of sympathetic innervation of muscles. A critical review of recent advances in orthopædics might be expected to contain some reference to these and other physiological problems. The physiological principles involved in tendon transplantation are also worthy of consideration, but are ignored; for example, Mr. Tubby would advise the transplantation of a part of the triceps into the biceps; that is, of a muscle into its direct antagonist, a method considered unsound by those who like to transplant muscles into their synergic assistants.

At the end of the book the principles of re-education are briefly mentioned, and a few paragraphs devoted to the question of the organization of orthopædic work and of the care of cripples. This important side of orthopædics is now receiving much attention from public authorities, and great progress is being made owing to the efforts of private individuals and others.

Tumours of the Spinal Cord. By CHAS. A. ELSBERG, M.D., Professor of Neurological Surgery, Columbia University. Royal 8vo. Pp. 421 + viii, with 354 illustrations. 1925. London: H. K. Lewis & Co. Ltd. £2 10s. net.

ELSBERG'S book is based upon a study of 81 cases of spinal-cord tumour upon which he has operated. An interesting historical introductory chapter is followed by some 230 pages of detailed case reports, which constitute about 60 per cent of the entire volume. The symptomatology, morbid anatomy, and treatment are clearly discussed in the succeeding chapters. The operation of laminectomy which he performs is, in all essential respects, that which was employed by Victor Horsley, and he rightly deprecates the cramping osteoplastic operations and 'hemi-laminectomies' which have from time to time been advocated by other surgeons.

The fairly common and very definite condition of meningitis circumscripta serosa which Horsely described is only briefly alluded to, and it is somewhat surprising that in so large an experience Elsberg should attach so little importance to this condition as a cause of compression paraplegia. Sicard's lipiodol-radiographic method of localization scarcely receives the notice which it deserves.

The book is an excellent work of reference, is well illustrated, and contains a good bibliography.

Surgical Treatment of Pulmonary and Pleural Tuberculosis. By J. GRAVESEN, Copenhagen. Pp. 155, with 87 illustrations (3 in colour). 1925. London: John Bale, Sons & Danielsson. 10s. 6d.

To those who are interested in the surgical treatment of advanced phthisis this book will prove useful, as it goes carefully into the question of the indications and contra-indications for the developing of artificial pneumothorax, the choice of the methods in collapse therapy, the details and advantages of thoracoscopy, and the operation of extrapleural thoracoplasty.

The book is well illustrated and well printed, and should serve a useful purpose.

Die Chirurgie der Brustorgane. By FERDINAND SAUERBRUCH. Vol. II. Pp. 1075 + xxxi, with 720 illustrations. 1925. Berlin: Julius Springer. G.M. 258 (= £12 18s.)

THE first volume of this work was published in 1921. It contained the anatomy and physiology of respiration, the general pathology of diseases of the thorax, diagnosis of thoracic diseases, methods of anæsthesia, the uses of pressure chambers, and the general technique of thoracic surgery. Now Sauerbruch brings his work to completion by the publication of his second volume, a large book of 1075 pages and 720 illustrations, many of them in colour. This volume deals with the surgery of the heart and pericardium, the large blood-vessels, the mediastinum, the œsophagus, diaphragm, and breast, and included in it is the second edition of the *Technik der Thoraxchirurgie* originally published by Sauerbruch and Schumacher in 1911.

The book is a landmark in the literature of thoracic surgery, and the greatest credit must be given to the author for his painstaking work in pioneer surgery, and for the energy needed to produce such a work unqualified praise is due.

Traité pratique d'Orthopédie. By Dr. G. POTEL, Professor at the Faculty of Medicine at Lille. Royal 8vo. Pp. 734, with 399 figures in the text and 4 coloured plates. 1924. Paris: Gaston Doin. Fr. 80.

WE have thoroughly enjoyed the reading of Professor Potel's work, although the enjoyment has been at times tempered by disappointment at the small space he devotes to treatment. Surgical proceedings of every-day occurrence are dismissed with a curt account, which would afford a very poor guide to any surgeon who wished to perform them. For example, only eleven lines are devoted to the description of Albee's operation on the spine.

Professor Potel wishes to exclude from his work all obsolete methods and all methods still in the experimental stage, and in this he is right; but he also dismisses in a few words methods which can claim a very fair amount of success, such as Stöffel's operation for spastic paralysis.

To pass from adverse comment to real appreciation. With typical French thoroughness and painstaking, Professor Potel has given us, if not the first, at any rate the best scientific classification and pathology of congenital deformities. An immense amount of patient observation and collection must have been needed for this. His explanation of certain congenital deformities such as 'torticollis' and 'club-foot' by a theory of relative muscular insufficiency or dystrophy appeals to us, and seems to explain the observed phenomena better than other theories. Especially does it explain the tendency to relapse after efficient correction as growth proceeds, and emphasizes the necessity for constant supervision for many years. Amniotic bands are rightly relegated to a place of minor importance as causative factors. The varieties of spina bifida and meningocele are well and accurately described, and are illustrated by excellent coloured diagrams. As we have mentioned above, spastic paralysis is ably but too briefly dealt with.

The second part deals with acquired deformities. Postural deformities of the spine are well described. Professor Potel takes a modern and, as we think, correct broad view of their causation, without giving to habitual faulty attitude an importance greater than its deserts. Pott's disease has been well studied in France, and is, as we should expect, well described, including the treatment, with the exception of treatment by operation.

For the rest, ununited fractures, ankylosis of joints, etc., are treated at length,

and we are pleased to see these subjects included in a book on orthopædics. Professor Potel's views we think excellent, especially his evident dislike of the use of foreign, metallic bodies for bone fixation.

On the whole the book is a very pleasing one, written in excellent style, and occasionally witty; we think that Professor Potel, having done so much, would be well advised to expand the sections devoted to treatment in the next edition, and give us a work of standard value from cover to cover.

Patologia e Chirurgia della Milza. By Professor L. SILVESTRINI. Large crown 8vo. Pp. 402, illustrated. 1924. Bologna: Capelli. Lire 35.

THIS most interesting manual covers the ground of splenic pathology as required by the surgeon. It opens with chapters on the anatomy, physiology, and pathology of the spleen; passes to a description of misplacements, ruptures, and wounds; discusses the enlargements associated with syphilis, tuberculosis, malaria, and leishmaniasis; and takes up the study of cysts, vascular tumours, and malignant neoplasms, giving adequate descriptions of the conditions based on wide reading.

When it comes to dealing with the difficult and important subject of the splenic anæmias, the author, for all his industry, cannot get beyond the region of nice distinctions without essential differences. He has sections on the infantile form of Cardarelli-Jaksch, on the type Griesinger-Banti, on Banti's disease proper, on chronic icteric splenomegaly, on splenomegaly hæmolytica; but is forced to admit the encroachment of the one type on the other, and whilst recognizing the clinical value of splenectomy in all, rationalizes the procedure on seemingly contradictory hypotheses. In this he is, of course, not to blame, for the functions of the spleen are imperfectly understood, and vary at different age periods, in different phases of metabolic instability, and under the influence of noxa at present merely guessed at. From the study of this group he passes to the allied condition of pernicious anæmia, purpura hæmorrhagica, and so on. There is an absence of discussion of cases in which the pancreas must be included in the syndrome.

A third part is devoted to surgical procedures, describing, besides splenectomy, the various partial substitutes for removal.

The style is easy, and clearly the work is that of a man who is not only deeply interested in the clinical aspect of the subject, but also has that intimate acquaintance with the underlying pathology which comes of devotion to its experimental investigation. There is an extensive bibliography.

Die örtliche Betäubung. Von PROFESSOR DR. HEINRICH BRAUN, Gen. med. Direktor des Krankenstiftes in Zwickau. Seventh edition. Medium 8vo. Pp. 511, illustrated. 1925. Leipzig: J. A. Barth. R.-m. 22.50.

THIS new edition of Braun's well-known work has been brought thoroughly up to date. It is, perhaps, the most reliable and authoritative book on the subject. The section dealing with local anæsthetic methods in operations upon the neck has been completely re-written. Very interesting is the chapter on abdominal surgery. Here the author's remarks are well worth attention. He maintains that general anæsthesia plays only a small part in causing post-operative pulmonary complications, the proportion of which is not greatly lowered by the use of local anæsthesia. Yet there are special indications, and on occasion local anæsthesia is the method of choice. The author does not advocate the paravertebral procedure, partly because so much novocain must be injected, partly because it is difficult always to ensure that every one of the eighteen to twenty-two nerves has been reached by the anæsthetic, partly because it imposes rather a severe strain upon both patient and surgeon. Splanchnic anæsthesia Braun regards as a great advance in abdominal methods. He employs the anterior route after opening the abdomen, but admits that in some cases a short general ethyl-chloride anæsthesia is necessary to carry out the splanchnic procedure. English surgeons as a body will probably not be inclined to agree with him that the problem of local anæsthesia for operations in the upper abdomen is solved by splanchnic methods. The rest of the book fully maintains the high standard reached in previous editions. To those interested in local anæsthesia there could be no better guide.